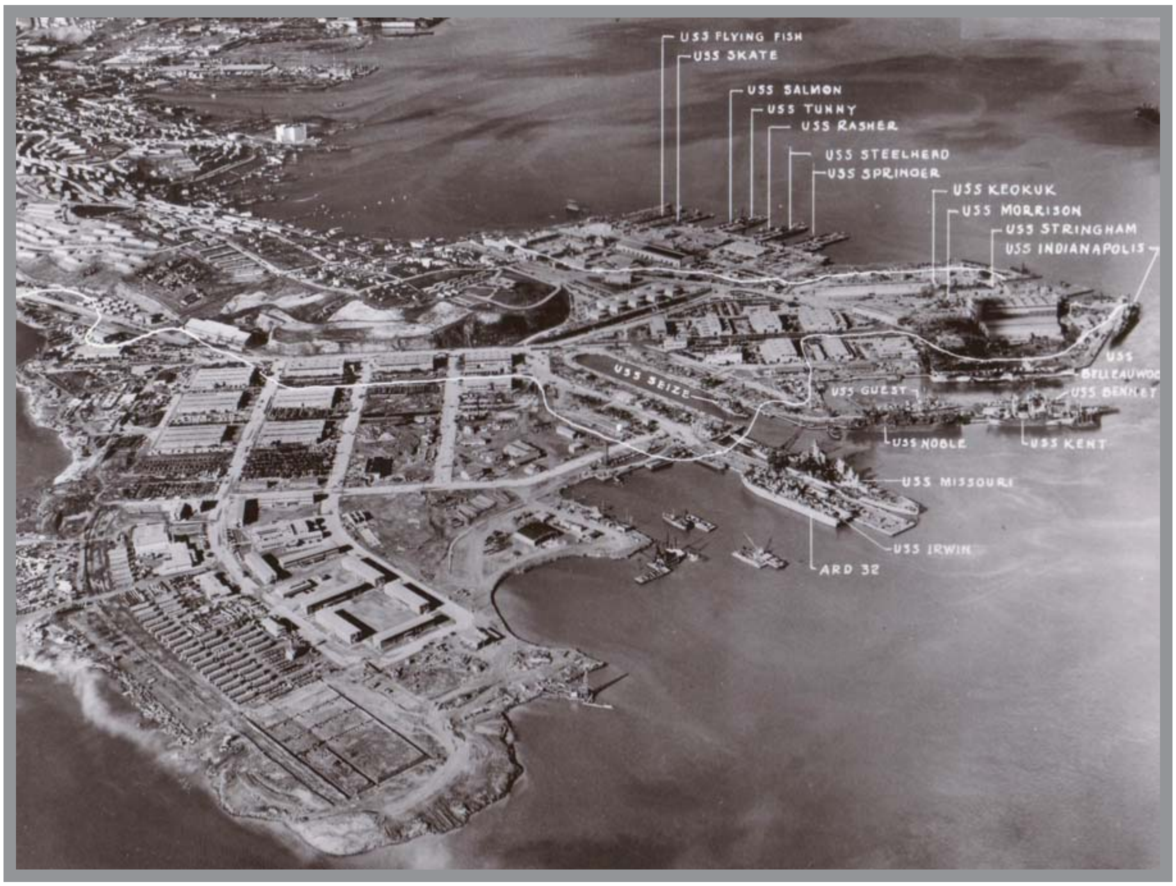
Hunters Point Shipyard

DRAFT FINAL
HISTORICAL RADIOLOGICAL ASSESSMENT
VOLUME II

History of the Use of General Radioactive Materials 1939 – 2003



NAVSEA
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LIST OF ABBREVIATIONS, ACRONYMS, AND SYMBOLS

µCi	Microcurie
µCi/cc	Microcurie per cubic centimeter
µg	Microgram
µrem/hr	Microrem per hour (also expressed as µR/hr)
A/C	Asphalt/concrete
Ac-227	Actinium-227
AD	Auxiliary Destroyer Tender
AEA	Atomic Energy Act
AEC	Atomic Energy Commission
AFSWP	Armed Forces Special Weapons Program
AG	Miscellaneous Auxiliary Ship
AGC	Amphibious Force Flagship
AGS	Auxiliary Survey Ship
AH	Auxiliary Hospital Ship
AKA	Attack Cargo Ship
AKS	Auxiliary Stores Issue Ship
Am-241	Americium-241
Am-243	Americium-243
AN	Auxiliary Net Laying Ship
AO	Auxiliary Oiler Ship
AOG	Auxiliary Gasoline Tanker
AP	Auxiliary Transport
APA	Auxiliary Attack Transport
APB	Auxiliary Self Propelled Barracks Ship
APD	Auxiliary High Speed Transport
APL	Auxiliary Non-Self Propelled Barracks Ship
AR	Auxiliary Repair Ship
ARB	Auxiliary Battle Damage Repair Ship
ARD	Auxiliary Floating Dry Dock
ARDC	Auxiliary Floating Dry Dock Concrete
ARG	Auxiliary Internal Combustion Engine Repair Ship
ARL	Auxiliary Landing Craft Repair Ship
ARSD	Auxiliary Salvage Lifting Ship
AS	Auxiliary Submarine Tender
ASR	Auxiliary Submarine Rescue Ship
ATA	Auxiliary Ocean Tug
ATF	Amphibious Tug Fleet

ATR	Rescue Ocean Tug
ATG	Allied Technology Group, Inc.
Au-198	Gold-198
AV	Auxiliary Aviation Ship
AVP	Small Seaplane Tender
AW	Auxiliary Distilling Ship
Ba-140	Barium-140
Bay	San Francisco Bay
BB	Battleship
BCT	BRAC Cleanup Team
bgs	Below ground surface
BOQ	Bachelor Officers Quarters
Br-82	Bromine-82
BRAC	Base Realignment and Closure
BUMED	Navy Bureau of Medicine and Surgery
BUSHIPS	Navy Bureau of Ships
C-14	Carbon-14
CA	Heavy Cruiser
CAE	Committee on Atomic Energy
Cd-121	Cadmium-121
CDHS	California Department of Health Services
cc	Cubic centimeter
Ce-144	Cerium-144
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CERCLIS	CERCLA Information System
Ci	Curie
Cf-252	Californium-252
CFR	*Code of Federal Regulations*
Cm-244	Curium-244
CNO	Chief of Naval Operations
CO_2	Carbon dioxide
Co-60	Cobalt-60
Cr-51	Chromium-51
Cs-137	Cesium-137
CV	Aircraft Carrier
CVE	Escort Aircraft Carrier
CVL	Aircraft Carrier Light

DD	Destroyer
DERP	Defense Environmental Restoration Program
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
dpm	Disintegration per minute
dpm/100 cm^2	Disintegration per minute per 100 square centimeters
DRMO	Defense Reutilization and Marketing Office
DTSC	Department of Toxic Substances Control
EFA WEST	Engineering Field Activity West, Naval Facilities Engineering Command
ELCR	Excess lifetime cancer risk
EPA	U.S. Environmental Protection Agency
ERDA	U.S. Energy Research and Development Administration
Eu-152	Europium-152
Eu-154	Europium-154
FFA	Federal Facility Agreement
FS	Feasibility Study
FSS	Final Status Survey
FUDS	Formerly used defense site
gpm	Gallons per minute
G-RAM	General radioactive material
GSA	General Services Administration
GU	Guam, Marianas Islands
H-3	Tritium
Hg-203	Mercury-203
HLA	Harding Lawson Associates
HP	Hunters Point
HPNSY	Hunters Point Naval Shipyard
HPS	Hunters Point Shipyard
HRA	Historical Radiological Assessment
HRS	Hazard Ranking System
IAS	Initial Assessment Study
ICW	Islais Creek Warehouse
IDW	Investigation-derived waste
IR	Installation Restoration
Ir-192	Iridium-192
IX	Unclassified Miscellaneous Ship

JTF-1	Joint Task Force One
K-40	Potassium-40
K-42	Potassium-42
KA	Kwajalein Atoll
kg	Kilogram
kV	Kilovolt
La-140	Lanthanum-140
LA	Los Angeles
LCI	Landing Craft Infantry Ship
LFE	LFE Environmental Analysis Laboratories, Inc.
LLRW	Low-level radioactive waste
LSD	Amphibious Dock Landing Ship
LSM	Amphibious Medium Landing Ship
LST	Amphibious Tank Landing Ship
Lu-177	Lutetium-177
MARAD	Maritime Administration
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
Pm-147	Promethium-147
mCi	Millicurie
MDA	Minimum detectable activity
meV	Megaelectron volt
MI	Mare Island
MINS	Mare Island Naval Shipyard
MINSY	Mare Island Naval Shipyard
mR/hr	Milliroentgen per hour
mrem	Millirem
mrem/hr	Millirem per hour (also expressed as mR/hr)
msl	Mean sea level
MSTS	Military Sea Transport Service
N/A	Not applicable
Na-24	Sodium 24
NACIP	Naval Assessment and Control of Installation Pollutants
NaI	Sodium iodide
NARA	National Archives and Records Administration
NAREL	National Air and Radiation Environmental Laboratory
NARM	Naturally Occurring Accelerator-Produced Radioactive Material
NAS	Naval Air Station

NAVFAC	Naval Facilities Engineering Command
Navy	U.S. Department of the Navy
NAVSEA	Naval Sea Systems Command
NAVSESDET RASO	Naval Sea Systems Command Detachment, Radiological Affairs Support Office (also expressed as RASO)
NC	Non-commissioned
nCi	Nanocurie
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NDT	Non-destructive test(ing)
NEESA	Naval Energy and Environmental Support Activity
NNPP	Naval Nuclear Propulsion Program
NORM	Naturally Occurring Radioactive Material
Np-237	Neptunium-237
NPL	National Priorities List
NRC	U.S. Nuclear Regulatory Commission
NRDL	Naval Radiological Defense Laboratory
NRSC	Naval Radiation Safety Committee
NUREG	Nuclear Regulatory Guide
NWT	New World Technology
OP	Operational
PA	Preliminary Assessment
Pa-234	Protactinium-234
Pb-210	Lead-210
Pb-214	Lead-214
PCB	Polychlorinated biphenyl
pCi/g	Picocurie per gram
pCi/L	Picocurie per liter
PG&E	Pacific Gas and Electric Company
PGM	Patrol Motor Gunboat
PH	Pearl Harbor
Pm-147	Promethium-147
Pu-239	Plutonium-239
Po-210	Polonium 210
Po-Be	Polonium-beryllium
PRC	PRC Environmental Management, Inc.
PRG	Preliminary remediation goal
PS	Puget Sound
PSNS	Puget Sound Naval Shipyard
PT HUE	Point Hueneme

Pu-Be	Plutonium-beryllium
Pu-239	Plutonium-239
Ra-226	Radium-226
RAB	Restoration Advisory Board
RADLAB	Radiation Laboratory
RADIAC	Radiation Detection, Indication, and Computation instrument
RASO	Radiological Affairs Support Office
RASP	Radiological Affairs Support Program
Rb-86	Rubidium-86
rem	Roentgen equivalent man
RI	Remedial Investigation
RIC	Radioisotope Committee
RME	Reasonable maximum exposure
Rn-222	Radon-222
RPTD	Reported
RSH	Radiological Safety Headquarters
RSS	Radiological Safety Section
RWQCB	Regional Water Quality Control Board
SAP	Security Assistance Program
SARA	Superfund Amendments and Reauthorization Act of 1986
SCRS	Surface confirmation radiation survey
SD	San Diego
SDAT	Ship decontamination from atomic testing
SF	San Francisco
SFBNSY	San Francisco Bay Naval Shipyard
SFNS	San Francisco Naval Shipyard
SI	Site Inspection
Smith-Emery	Smith-Emery Company
SNAP	Special Nuclear Auxiliary Power
Sr-90	Strontium-90
SS	Submarine
SSN	Submarine, Nuclear
Sub-Base Area	Submarine Base Area
SUPSHIP	Supervisor of Shipbuilding, Conversion, and Repair
SWDIV	Southwest Division, Naval Facilities Engineering Command
Ta-182	Tantalum-182
Th-228	Thorium-228
Th-232	Thorium-232
Tm-170	Thulium-170

Tm-171	Thulium-171
TNT	Trinitrotoluene
Triple A	Triple A Machine Shop, Inc.
TtEMI	Tetra Tech EM Inc.
U-233	Uranium-233
U-235	Uranium-235
U-236	Uranium-236
U-238	Uranium-238
USACE	U.S. Army Corps of Engineers
USC	*United States Code*
USCG	U.S. Coast Guard
USMC	United States Marine Corps
USN	United States Navy
USS	United States Ship
WAGL	Coast Guard Buoy Tender
Xe-133	Xenon-133
Y-90	Yttrium-90
YAG	Miscellaneous Auxiliary Service Craft
YFN	Barge
YFNX	Barge
YMS	Minesweeper

GLOSSARY

AEC: Atomic Energy Commission. Federal agency created in 1946 to manage the development, use, and control of nuclear energy for military and civilian applications. Succeeded by the Energy Research and Development Administration (now part of the U.S. Department of Energy) and the U.S. Nuclear Regulatory Commission.

Aggregate: A clustered mass of individual soil products varied in shape and size (such as soils, sand, and rock).

Air: Atmosphere that becomes a migration pathway for resuspension and disposal of radioactive contamination and contaminated media.

Alpha particle: A positively charged particle ejected spontaneously from the nuclei of some radioactive elements. Alpha particles can be stopped by a thin sheet of paper.

Analytical method: Techniques used to quantitatively and qualitatively measure radioactivity. The work conducted at Hunters Point Shipyard (HPS) mainly involved radioisotopes that could be identified using gamma spectroscopy systems calibrated to detect all radionuclides with gamma energies in the range of 60 kiloelectron volts to 3 megaelectron volts. HPS and Naval Radiological Defense Laboratory (NRDL) used general radioactive materials (G-RAM) that emitted alpha particles, beta particles, and gamma rays. Analytical methods for these isotopes include alpha spectroscopy, gross beta analysis, gamma spectroscopy, and high-purity germanium gamma photon detection. The type of radiation emitted and the physical characteristics of the isotope and sample are used to determine the most appropriate analytical method.

Aquifer: A saturated subsurface zone from which water is drawn.

Aquitard: A layer of rock not easily dissolved with carbonic acid such as limestone. Aquitards usually prevent water from traveling vertically but also allow water to move horizontally great distances underground.

Anomaly: An irregularity or a deviation from what is expected. A G-RAM anomaly would be identification of radiation levels above background radiation levels.

Background radiation: Naturally occurring radiation from cosmic or terrestrial sources.

Beta particle: A charged particle emitted from a nucleus during radioactive decay with a mass equal to 1/1837 that of a proton. Negatively charged beta particles are electrons, and positively charged particles are positrons. Beta particles can be stopped by a thin sheet of plastic.

Base Closure and Realignment Act of 1990: The Defense Base Closure and Realignment Act of 1990, as amended (Public Law 101-510), was enacted by the U.S. Congress to provide a fair process that will result in timely closure and realignment of military installations in the United States. Navy uses the BRAC Program to comply with this Act.

Base Realignment and Closure (BRAC) Program: A formal Navy program managed by the Naval Facilities Engineering Command that was created in 1993 to dispose of excess Navy and Marine Corps properties, designated for closure or realignment by the U.S. Congress, by transfer to the local communities for reuse and economic revitalization.

BUMED: Navy Bureau of Medicine and Surgery. BUMED is responsible for the Navy's Radiation Health Program.

BUSHIPS: A former Navy bureau that was responsible for ships.

CDHS: California Department of Health Services.

CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act of 1980. Legislation that established the federal Superfund for response to uncontrolled releases of hazardous substances to the environment.

CERCLIS: Comprehensive Environmental Response, Compensation, and Liability Act Information System: U.S. Environmental Protection Agency's computerized inventory and tracking system for potential hazardous waste sites.

<u>Characterization survey</u>: Site assessments generally taken after radioactive contamination has been confirmed in an impacted site by a scoping survey. The survey determines the extent of contamination and identifies and defines the extent of radionuclides of concern. These surveys include in-depth surveys, sampling, monitoring, and analysis necessary to develop, analyze, and select appropriate cleanup techniques.

<u>Class 1 area (based on the Multi-Agency Radiation Survey and Site Investigation Manual [MARSSIM])</u>: An area having the highest potential for G-RAM contamination. Examples of Class 1 areas include (1) areas previously subject to remedial actions, (2) locations where leaks or spills are known to have occurred, (3) former burial or disposal sites, (4) waste storage sites, and (5) areas containing contaminants in discrete solid pieces of material with high specific activity.

<u>Class 2 area (based on MARSSIM)</u>: An area having a moderate potential for G-RAM contamination. Examples of areas that might be reclassified as Class 2 include (1) locations where radioactive materials were present in an unsealed form, (2) potential contaminated transport routes, (3) areas downwind from stack release points, (4) upper walls and ceilings of buildings or rooms subjected to airborne radioactivity, (5) areas handling low concentrations of radioactive materials, and (6) areas on the perimeter of former contamination control areas.

<u>Class 3 area (based on MARSSIM)</u>: An area having slight or no potential for G-RAM contamination. Examples of areas that might be classified as Class 3 include buffer zones around Class 1 and Class 2 areas and areas with very low potential for residual contamination but insufficient information to justify a non-impacted classification.

<u>Class 1 survey</u>: Surveys of an impacted site that has a high potential for radioactive contamination, is known to have contamination, or had a prior remediation to remove radioactive contamination. This includes areas with contamination in excess of release limits based on a scoping or characterization survey or areas where previous Class 2 or 3 surveys found contamination above the release limits. Class 1 surveys cover 100 percent of the site.

Class 2 survey: Surveys of an impacted site recognized as having a potential for radioactive contamination but the contamination is not expected to exceed release limits. This includes areas known to contain minor isolated areas of contamination with low potential for exposure, buffer zones around Class 1 areas, or areas where previous Class 3 surveys found contamination. Class 2 surveys can cover 10 to 100 percent of the site.

Class 3 survey: Surveys of an impacted site that is not expected to contain residual contamination exceeding the release limit. This includes buffer zones around Class 1 or 2 areas or previously decontaminated and surveyed areas. The percentage of the site covered by Class 3 surveys is not standardized, and surveys may be conducted randomly.

Contaminated media: Materials at an impacted site that contain, or are suspected of containing, radioactive contamination or to which radioactive contamination may have migrated.

Contaminated media assessment: A rating of the potential contamination media or migration at an impacted site.

CNO: Chief of Naval Operations.

Contamination potential: The possibility for residual radioactive contamination at an impacted site that has been determined through a professional evaluation of historical information, previous survey results, and site reconnaissance.

Curie: Abbreviated Ci. A unit of measure of the amount of radioactivity equal to 3.7×10^{10} disintegrations per second or 2.22×10^{12} disintegrations per minute (dpm).

Cyclotron: A particle accelerator with a roughly circular pathway.

Decontamination: The reduction or removal of radioactive material from a structure, object, or person. Accomplished by treating the surface to remove or decrease the contamination or by letting the material decrease as a result of radioactive decay.

Direct measurement: Measurement of alpha, beta, or gamma radiation. Data can be displayed as a digital rate, timed count, or integrated dose count.

Dose: The amount of energy absorbed by a person exposed to radiation.

Drainage system: Sanitary drains, facility storm drains, or septic systems and leach fields. This category can include bay sediments where drainage to the bay occurs.

Emergency action: Immediate remediation or containment is required because the levels of radioactive contamination or radiation exposure are such that there is a high potential for significant exposure or release of radioactive materials to the public or the environment.

EPA: U.S. Environmental Protection Agency. The lead federal regulatory agency under CERCLA for cleanup of hazardous waste sites on the National Priority List (NPL).

FFA: Federal Facility Agreement. An agreement among the EPA, state, and site lead agency (for example, the Navy) detailing the extent and schedule of remedial actions.

Final Status Survey: Also stated as FSS. Assessment taken after historical documentation or previous investigations or remediations indicate radioactive contamination has been removed from an impacted site. The survey verifies that an impacted site complies with applicable release criteria by taking the appropriate measurements and sampling that will define the radiological condition of a site.

Franciscan Complex Bedrock: An assortment of sedimentary rocks deposited in seawater at many depths and in widely separated parts of the ocean.

Free release: A recommendation made after historical documentation and previous and current investigations and surveys indicate all applicable release criteria have been met and the site is ready for review by Navy and regulatory agencies for future non-radiological use.

Gamma radiation: High-energy, short-wave length electromagnetic radiation emitted from the nucleus of an atom. Gamma radiation frequently accompanies the emission of alpha and beta particles and always accompanies fission. Gamma rays are stopped by shielding with heavy materials such as lead.

G-RAM: All general radioactive materials that are not associated with the Naval Nuclear Propulsion Program (NNPP).

Groundwater: Waters contained in subsurface materials and aquifers.

Half-life: Time required for a population of atoms of a given radionuclide to decrease through radioactive decay to exactly one-half of the original number of atoms. No operation, either chemical or physical, can change the decay rate of a radioactive substance. Half-lives range from much less than 1 microsecond to more than 1 billion years. The longer the half-life, the more stable the nuclide. After one half-life, half of the original atoms will remain; after two half-lives, one fourth (or 1/2 of 1/2) will remain; and so on.

Hazardous material: Material that possess properties of radioactivity, chemical toxicity, or other potential nuisance to cause human illness or injury.

Hazardous substance: Any material that poses a threat to human health and/or the environment. Typical hazardous substances are toxic, corrosive, ignitable, explosive, or chemically reactive.

High: Contaminated assessment indicating that evidence of contamination in the media or migration pathway has been identified.

HRA: Historical Radiological Assessment. A detailed investigation to collect historical radiological information and data derived from environmental monitoring for a particular site and its surroundings where radioactive materials were used. The HRA is comparable to the Historical Site Assessment as defined in MARSSIM.

HSA: Historical Site Assessment. MARSSIM terminology for an historical radiological assessment. See HRA above.

Impacted area: An area that has or historically had a potential for G-RAM contamination based on the site operating history or known contamination detected during previous radiation surveys. Impacted sites include sites where radioactive materials were used or stored; sites where known spills, discharges, or other instances involving radioactive materials have occurred; or sites where radioactive materials might have been disposed of or buried. Impacted sites are ranked as Class 1, 2, or 3 based on MARSSIM guidelines.

Investigation level: A radionuclide-specific level based on the release criterion that, if exceeded, triggers some response such as further investigation or remediation.

Kevatron: A low order, several hundred kiloelectron Volts particle accelerator.

Known-Continued Access Contamination Potential: Low levels of contamination exist, but the contamination is contained in system, fixed on building surfaces, or is in generally inaccessible areas.

Known-Restricted Access Contamination Potential: Radioactive contamination is known to exist at levels that could be hazardous without protective clothing, respiratory protection, or radiation monitoring.

Liberty Ship: Liberty Ship was the name given to the EC2-type ship designed for "Emergency" construction by the United States Maritime Commission in World War II (WW II). The largest class of merchant ships ever built (2,751), they were simple square-hulled vessels, welded and hammered together. They carried cargoes of grain and mail, ore and ammunition, tanks, trucks, and troops. Their expected life span was only 5 years, and so great was the expected casualty rate that the Navy considered one safe voyage per ship a full quota.

Likely Contamination Potential: Residual radioactive contamination is expected but has not been confirmed.

Low: Assessment of contaminated media or migration pathway indicating that the contamination potential is remote.

Media: Types of materials at an impacted site that may contain or are suspected of containing radioactive contamination or to which radioactive contamination may migrate.

Micro: Abbreviated μ. A prefix denoting one-millionth (10^{-6}).

Migration pathway: Media or transport mechanisms that allow radioactive contamination to spread in the immediate vicinity of the contaminated media.

Milli: Abbreviated m. A prefix denoting one-thousandth (10^{-3}).

Moderate: Assessment of contamination media or migration pathway that indicates the potential for contamination exists but has not been fully assessed.

Mudflat: An intertidal (or periodically exposed) expanse of mud characterized by mobile fine sediments and typically rich in fauna.

Nondestructive testing (NDT): An inspection technique that involves examining the structure of materials without destruction or physical change to the materials being examined. Industrial radiography using an ionizing radiation source to inspect metals and welds to ensure integrity and structure is one type of NDT. Machine sources of ionizing radiation (x-ray machines) may also be used to perform NDT.

None: Assessment of contaminated media or migration pathway that indicates evidence of contamination has not been found or known contamination has been removed and surveys indicate that the media or migration pathway meets release criteria.

NNPP: Naval Nuclear Propulsion Program. A joint Navy and U.S. Department of Energy program to design, build, operate, maintain, and oversee operation of Naval nuclear-powered ships and associated support facilities.

Non-impacted area: An area having no reasonable possibility of residual G-RAM contamination resulting from site operations based on historical documents. Includes residential or other buildings that have or had no sealed radioactive sources other than smoke detectors or exit signs.

No Contamination Potential (None): Radioactive contamination has been fully assessed and removed, if necessary, and the site has been free released by the Navy and the regulatory agencies.

NPL: National Priorities List. Under the Superfund program, a list of sites of releases and potential releases of hazardous substances, pollutants, and contaminants that appear to pose the greatest threat to public health, welfare, and the environment.

NRC: U.S. Nuclear Regulatory Commission. An organization of the federal government that oversees and authorizes the use of byproduct, source, and special nuclear materials.

NRDL: Naval Radiological Defense Laboratory. A Navy command based at HPS from 1948 and until 1969. The mission of NRDL was the study of nuclear weapons effects and the development of countermeasures to the atomic weapon and decontamination methods for ships from OPERATION CROSSROADS.

NRMP: Naval Radioactive Materials Permit. Site-specific or broad-scope Navy license for the use of specified radioactive materials under specified conditions. These permits are issued by the Naval Radiation Safety Committee (NRSC) under the authority of the Master Materials License granted to the Navy by the NRC.

NRSC: Naval Radiation Safety Committee. Navy organization providing administrative control of all NRC-licensed radioactive material used by the Navy and U.S. Marine Corps.

Nuclide: Any known isotope, either stable or unstable, of any element. A single element can have isotopes, but when referring to isotopes of more than one element, the proper term is nuclide.

NUREG: Nuclear Regulatory Commission's implementation guidance document.

Petrographic: A mineralogical study of information used in the identification process of rocks and minerals.

Pico: Abbreviated p. A prefix denoting one-trillionth (10^{-12}).

Pig: A radioactive source container, which can be the housing unit, transport unit, and/or an exposure controlling device.

<u>RADIAC</u>: Radiation Detection, Indication, and Computation instruments used to measure radiation emission rate or exposure.

<u>Radiography</u>: The process of examining a person, animal, object, or structure below the surface without injury or incursion using a radioactive source or a machine source of ionizing radiation.

<u>Radioisotope</u>: An unstable isotope of an element that decays or disintegrates spontaneously, emitting radiation. These elements have the same number of protons but different numbers of neutrons in their nuclei. Approximately 3,700 natural and artificial radioisotopes have been identified.

<u>Radioluminescence</u>: Luminescence produced by the bombardment of radiant energy such as x-rays, radioactive waves, or alpha particles on a material such as phosphors.

<u>Radioluminescent device</u>: An item containing radioluminescent paint that allows the device to be seen in the dark. These devices were commonly used by the Navy and possibly contained radium-226, strontium-90, tritium, or promethium-147.

<u>Radioluminescent paint</u>: A paint containing a radioisotope that interacts with a phosphor to produce radioluminescence. The paint was commonly applied to devices that needed to be seen in areas without natural or artificial lighting.

<u>Radionuclide</u>: An unstable nuclide or isotope.

<u>Radiologically impacted</u>: An area, building, or piece of equipment that, under professional interpretation, has the distinct possibility of having residual radioactive material associated with it.

<u>RASO</u>: The Naval Sea Systems Command Detachment, Radiological Affairs Support Office, located in Yorktown, Virginia. RASO's provide technical support to the Navy for management and control of G-RAM.

Release criterion: A regulatory limit established to set a limit for decontamination of residual radioactive contamination. The term may be expressed as a quantification of radioactivity, dose, or exposure risk.

rem: Roentgen equivalent in man. A measure of radiation dose that is an estimate of the potential biological damage resulting from radiation exposure.

Roentgen: A unit of exposure.

Scoping Survey: A survey to identify radionuclide contaminants, relative radionuclide ratios and general levels, and extent of contamination. These surveys usually include minimal surface scans, sampling, and dose rate assessments.

Source: A small device containing radioactive material. The device may be used in research and industrial processes and may be sealed or unsealed. Sealed sources are often part of specialized industrial devices that measure quantities such as the moisture content of soil or the density or thickness of materials (radiography or NDT). Sources are usually enclosed in a housing that prevents the escape of the radioactive materials. Often referred to as “radioactive sources” or “sealed sources.”

Spectroscopy: Physics that deals with the theory and interpretation of interactions of matter and radiation. Often used in the analysis of samples for quantification or qualification of radioactive content.

Structure: A man-made surface(s) above the surface or contained within subsurface media.

Subsurface soil and media: Solid materials and media found below the surface soils.

Surface soil: The top layer of soil (6 inches below ground surface), fill, gravel, waste piles, concrete, or asphalt that is available for direct exposure, growing plants, resuspension of particles for inhalation, and mixing from human disturbances.

Surface water: Waters found in streams, rivers, lakes, and oceans as well as coastal tidal waters.

Swipe sample: Type of sample collected to measure removable contamination on surfaces of alpha and beta particles.

Tolerance level: Levels were levels used for ship and materials clearance and radiation exposure before and after ship decontamination. Term was used during the early years, mainly concerned with OPERATION CROSSROADS ships and work on those ships.

Undifferentiated Sedimentary Deposits: Sediments consisting of varying types of sands, clays, soils, and rocks resulting from storm wash and river erosion.

Unknown Contamination Potential: Residual radioactive contamination potentially exists but no clear indication of possible contamination levels or contaminants has been established.

Unlikely Contamination Potential: Residual radioactive contamination is not expected but investigation is warranted.

Van de Graaff: A mechanical electric device that produces extremely high voltages at low, safe levels of electric current.

Weatherboard: A length of timber boarding (usually elm, now pine) fixed horizontally or vertically to the exterior of a structure.

Wetland: A type of sensitive environment sufficiently inundated or saturated by surface water or groundwater to support vegetation adapted for life under saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

1.0 EXECUTIVE SUMMARY

1.1 PURPOSE

This document, entitled *Historical Radiological Assessment, Volume II, Use of General Radioactive Materials, 1939-2003, Hunters Point Shipyard* presents a comprehensive history of radiological operations conducted by the U.S. Department of the Navy (Navy) and Navy contractors at the Hunters Point Shipyard (HPS), San Francisco, California. Located on San Francisco Bay (Bay) in southeastern San Francisco, HPS comprises approximately 936 acres, about half of which is below water. Known over the years as Hunters Point Naval Shipyard, San Francisco Naval Shipyard, San Francisco Bay Naval Shipyard, and Hunters Point Annex, the acronym HPS, rather than the historical name appropriate for the referenced time period, is used to identify the shipyard throughout this document.

The Navy has prepared the HPS Historical Radiological Assessment (HRA) as a two-volume set. Volume I, entitled *Historical Radiological Assessment, Hunters Point Annex, Volume I, Naval Nuclear Propulsion Program, 1966-1995*, was published in August 2000 and addressed radioactivity associated with the Naval Nuclear Propulsion Program (NNPP). Volume I concluded that berthing of and work on nuclear-powered ships at HPS resulted in no adverse effect on the human population or the environment.

Volume II of the HRA has been prepared pursuant to the Navy's Installation Restoration (IR) Program, which encompasses the Navy's Base Realignment and Closure (BRAC) Program, and in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA). The format and content follow the guidelines for a Historical Site Assessment established in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM.)

Volume II describes the history of operations involving general radioactive material (G-RAM) that, for the purposes of this document, is defined as any radioactive material used by the Navy or Navy contractors not associated with the NNPP. The two volumes are written by different organizations and published separately as different Naval Sea Systems Command

(NAVSEA) offices, with different historical controls and practices, that manage NNPP radioactive material and G-RAM.

1.2 HRA METHODOLOGY

The primary purpose of the HRA is to designate sites as impacted or non-impacted. An impacted site is one that has potential for radioactive contamination based on historical information, or is know to contain or have contained radioactive contamination. In many instances, designation as impacted does not confirm that radioactive contamination is present; only that the possibility exists and must be investigated. If contamination is found at an HPS-impacted site, measures will be taken to remove the contamination to below release levels. Because of the extensive use of radioactive materials by the Naval Radiological Defense Laboratory (NRDL), former NRDL facilities have been included as impacted sites. Once a site is designated as impacted, it remains “impacted” even after any residual contamination is removed.

A non-impacted site is one, based on historical documentation or results of previous radiological survey information, where there is no reasonable possibility for residual radioactive contamination. If new historical information becomes available or contamination is found at a non-impacted site, the site would be redesignated as “impacted.”

To designate sites as impacted or non-impacted, the HRA defines the extent of past radiological operations, assesses the likelihood of potential contamination and potential contamination migration pathways, and recommends future actions. As well as being used to designate impacted sites, this information can be used to support removal actions within the context of the U.S. Environmental Protection Agency’s (EPA) CERCLA process. As such, this HRA includes:

- Initial classification of areas that are impacted by radiological operations
- Historical information about radiological operations, investigations, and surveys
- Identification of potential, likely or known sources of radioactive material, radioactive contamination, and areas of use
- Assessments of the likelihood of areas of residual contamination

- Assessments of the likelihood of contamination migration
- Identification of sites that need further action as opposed to those posing no risk to human health or the environment from radiological operations
- Recommendations for future radiological investigations and remediation processes

The Navy researched multiple federal and personal archives to obtain information for preparation of the HRA. This research was supplemented by interviews of personnel with knowledge of radiological operations at HPS. Historical information was compared with evaluations made during site reconnaissance.

1.3 HISTORY

This HRA covers 64 years of radiological history at HPS from 1939 through June 2003. However, the shipyard only functioned as an active Navy-run repair facility from 1939 through 1974. After HPS ceased to function as an operational Navy shipyard in 1974, some HPS buildings and structures were leased to private tenants and Navy-related entities, the largest of which was Triple A Machine Shop, Inc. (Triple A), for ship repair operations. Buildings at HPS have also been leased for maritime and non-maritime industrial and artistic purposes. In addition, the Navy continued to use some buildings and structures for on-site oversight activities. The Navy resumed operation of the shipyard in 1986, when HPS was assigned as an annex to Naval Station Treasure Island. Throughout its history, HPS has been the subject of many radiological investigations. These investigations continue today.

Shipyard operations were permanently terminated on 29 December 1989. In 1991, HPS was placed on the Navy's BRAC list and its mission as a Navy shipyard ended on 1 April 1994. Engineering Field Activity West, Naval Facilities Engineering Command (EFA WEST), San Bruno, California, had initial oversight of base closure management of HPS. After closure of EFA WEST, this oversight authority was transferred to Southwest Division, Naval Facilities Engineering Command (SWDIV) in San Diego, California. SWDIV continues to manage the site today.

Details of the radiological history of HPS are provided in Section 6.0. Historical radiological operations included the following:

- Repair, use, and disposal of radioluminescent commodity items (dials, gauges, and deck markers)
- Gamma radiography for testing of metal and welds
- Calibration laboratory operations for ensuring radiation survey instrument accuracy
- Decontamination of and scientific research on ships contaminated during atomic weapons testing
- Use of various radionuclides for scientific research by the NRDL and its predecessors

Additionally, Mare Island Naval Shipyard (MINS) used berthing and drydock facilities at HPS between 1985 and 1989 for work on nuclear-powered ships. These activities were reported in Volume I of the HRA.

1.4 REGULATORY INVOLVEMENT

The Atomic Energy Commission (AEC) provided review and licensing of most uses of radioactive materials at HPS. Additional uses of radioactivity not controlled by the AEC included Naturally Occurring Radioactive Material (NORM) and Naturally Occurring Accelerator-Produced Radioactive Material (NARM) and machines that generate ionizing radiation (x-ray equipment). Because x-ray equipment does not produce residual radioactive materials or contamination, further discussion of such equipment will not be included in this document except as inclusions in the building use descriptions in Section 8.0 and as directly referenced in license descriptions or quotes from historical documents. A complete review of the uses of radioactive material and of regulatory involvement is provided in Section 5.0, with types of radioactive material used at each site detailed in Section 8.0. Types of radioactive material addressed in the HRA include:

- Radioactive material licensed by the AEC
- Generally licensed (no specific radioactive materials license required) commercial products containing G-RAM
- Equipment containing radioluminescent materials
- Residual contamination, including fission products and unspent radioactive weapons material, from atomic/nuclear weapons testing in the late 1940s through the early 1960s

1.5 ASSESSMENT SUMMARY

After a complete review of the radiological operations at HPS buildings, structures, and open areas, those with a history of radiological operations are designated as "impacted sites." This does not confirm the presence of radioactive contamination, but does indicate that there is the possibility for residual contamination. An assessment of contamination potential and contamination migration potential is provided for each of these sites with recommendations provided for future actions. In summary, this HRA has determined that:

- Of the 882 historical and current sites and support areas identified at HPS, 90 have been identified as radiologically impacted to some degree. The impacted sites include buildings; drydocks; former building sites; outdoor areas; IR sites; ships' berths; the Gun Mole Pier; and septic, sanitary, and storm drain systems.
- Twenty-eight impacted sites are recommended for review of the final status survey. This indicates either that the sites were surveyed and no contamination was found or, if contamination was found, remediation has been completed and additional surveys found no contamination above release limits. The site cannot be recommended for free release (any residual radioactive contamination is below today's release criteria) until the Navy and appropriate regulatory agencies have reviewed the final status survey report and agreed with the assessment. Site-specific final status survey reports will be issued separately from the HRA.
- Sixty impacted sites are recommended for further investigative actions or remediation. Four of these sites are formerly used defense sites (FUDS) and are under the jurisdiction of the U.S. Army Corps of Engineers (USACE).
- Two of the impacted sites, Building 816 and Building 821, have previously been verified as meeting state and federal safety standards and approved for unrestricted release by California Department of Health Services (CDHS). No further action is recommended for these two sites.
- Potentially contaminated media include surface soils, subsurface soil and media, structures and drainage systems.
- No concern for airborne contamination exists from the potentially contaminated media in their present undisturbed state.
- No impacted site is recommended for emergency action or identified with known contamination that requires restricted access.
- Only routine constraints to future remediation activities are recommended at this time because it is anticipated that future investigations will only find low-level concentrations of radioactive materials.

Section 8.0 provides specific details for each impacted site, including site description, former uses, current uses, radionuclides of concern, previous radiological investigations, assessment of potential contamination, identification of potential contaminated media and potential migration pathways, recommendations for future actions, and site maps.

1.6 CONCLUSIONS

The overall conclusion of the HRA is that low levels of radioactive contamination exist within the confines of HPS. However, shipyard tenants, the surrounding community, and the environment are not at risk from previous radiological activities at HPS.

2.0 INTRODUCTION

2.1 SCOPE

This document presents a comprehensive history of radiological operations conducted by the Navy and Navy contractors at HPS. Deactivated in 1974 by the Navy, HPS comprises approximately 936 acres, about half of which is below water. It is located along the Bay in southeastern San Francisco, California. Known over the years as Hunters Point Naval Shipyard, San Francisco Naval Shipyard, San Francisco Bay Naval Shipyard, and Hunters Point Annex, the acronym HPS, rather than the historical name appropriate for the referenced time period, is used to identify the shipyard throughout this document.

To present a complete history of the use of radioactive materials at HPS, the Navy has prepared the HPS HRA as a two-volume set. Volume I, entitled *Historical Radiological Assessment, Hunters Point Annex, Volume I, Naval Nuclear Propulsion Program, 1966-1995*, was published in August 2000 and addressed radioactivity associated with the NNPP. Volume I concluded that berthing of and working on nuclear-powered ships at HPS had no adverse effect on the human population or the environment.

This document, Volume II, describes the history of operations involving G-RAM, which is defined as any radioactive material used by the Navy or Navy contractors not associated with the NNPP. The two volumes were written and published under the direction of two different NAVSEA offices because NNPP radioactive material and G-RAM are managed by different Navy offices and have different historical controls and practices.

2.2 PURPOSE

The Navy uses HRAs to document the extent of past radiological operations at a specific site and residual effects these operations may have had on the site. HRAs meet the protocol for a Preliminary Assessment (PA), as defined by the EPA's CERCLA and can be used to support removal actions within the CERCLA process. The HRA also meets the definition of a Historical Site Assessment as defined by the MARSSIM **(HRA-2937)**.

The HPS HRA, Volume II, is unique because of the extensive radiological operations conducted at the site. Detailed in Section 6.0, these operations involved the use of radioactive materials by the following entities:

- HPS (San Francisco Naval Shipyard, Hunters Point Naval Shipyard, San Francisco Bay Naval Shipyard, and Hunters Point Annex)
- NRDL and its predecessors
- Triple A

Historical G-RAM operations conducted by these entities included:

- Repair, use, and disposal of radioluminescent commodity items (dials, gauges, and deck and personnel markers)
- Gamma radiography for assessment of metals and welds
- Calibration laboratory operations for ensuring radiological survey instrument accuracy
- Decontamination of and scientific research on ships contaminated during atomic weapons testing
- Scientific research on the effects of radioactivity on materials, plants, and animals

In addition to documenting the radiological history of a site, the Navy uses an HRA as a tool to assess, if any, the residual effect radiological operations may have had on buildings, structures, and open land areas. Assessments for the potential presence of radioactive materials result in designation of buildings, structures, and open areas as “non-impacted” or “impacted” sites. Non-impacted sites are considered to have no reasonable potential for residual radioactive contamination. A designation of impacted means the history of the site indicates that radioactive materials may have been used or stored there. At these sites, further investigation is required to verify that the building or area is not contaminated, that there is no potential for residual radioactive contamination at levels exceeding natural background or fallout, or that the site meets today’s release standards. Documentation of further investigation and/or remediation of impacted sites will be documented in separate reports.

2.3 REGULATORY BACKGROUND

The information in this HRA is being presented pursuant to the Navy's IR Program, which encompasses the Navy's BRAC Program. These programs function in accordance with CERCLA and SARA as directed by Executive Order 12316 of 20 August 1981, which required the U.S. Department of Defense (DoD) to comply with CERCLA.

The Navy instituted the Naval Assessment and Control of Installation Pollutants (NACIP) Program in the mid-1980s as a method of complying with CERCLA. The first step in the NACIP Program was to conduct an Initial Assessment Study (IAS) to assess potential contamination by hazardous materials, including radioactivity. The HPS IAS was completed in 1984 **(HRA-2969)**. The IAS findings, past hazardous materials control and disposal practices at HPS, and the close proximity to a drinking water source resulted in the EPA placing HPS on the National Priorities List (NPL) in 1989. Per Executive Order 12580, the Navy remains the lead agency to ensure compliance with CERCLA and SARA.

In 1990, the U.S. Congress called for the closure and release of HPS for reuse under the Base Closure and Realignment Act of 1988. A Federal Facility Agreement (FFA) signed on 22 January 1992, by the Navy, EPA, and the State of California, established cleanup actions and timeframes for HPS **(HRA-3138)**. On 21 January 1994, a memorandum of understanding was executed among the Navy, the City and County of San Francisco, and the City and County of San Francisco Redevelopment Agency to establish the process for the conveyance of the property at HPS for reuse **(HRA-2966)**. On 23 January 2002, a memorandum of agreement between the Navy and the City of San Francisco established the terms and conditions to be included in a binding and comprehensive agreement regarding the remediation and conveyance of HPS to the city **(HRA-2968)**.

The DoD has the authority to undertake CERCLA actions under Title 42 of the *United States Code* (USC), Section 9604; Title 10 of the USC, Section 2705; and Federal Executive Order 12580. Under the authority of CERCLA, DoD has undertaken the assessment of radioactive materials at HPS by conforming to the requirements of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), Title 40 of the *Code of Federal*

Regulations (CFR), Part 300. Because CERCLA defines radionuclides as hazardous substances, radionuclides are included in the CERCLA process to investigate, characterize, and remediate contamination. Appendix B of Title 40 of the CFR, Part 302.4 lists the specific radionuclides defined as CERCLA hazardous substances. Most of the radionuclides previously used at HPS are included on this list.

A consensus document of the EPA, DoD, the U.S. Department of Energy (DOE), and the U.S. Nuclear Regulatory Commission (NRC), MARSSIM provides detailed guidance for investigation of radiologically impacted sites. Developed to be consistent with CERCLA, MARSSIM uses a single-phase approach to address radioactive contamination issues versus CERCLA's multi-phased approach; that is, Site Inspection (SI), Remedial Investigation (RI), and Feasibility Study (FS). Once the presence of radioactive material has been identified and remediated at impacted sites, MARSSIM recommends a Final Status Survey (FSS) for radiological release of a site for unrestricted use to fulfill the CERCLA closure and post-closure process. Section 8.0 provides the current status of each impacted site with the appropriate recommendation to comply with MARSSIM.

2.4 REPORT ORGANIZATION

This HRA is organized to present the history of radiological operations at HPS from the beginning of Navy activities in 1939 through 30 June 2003, by providing the following information:

- Potential, likely, or known sources of G-RAM
- Potential, likely, and known areas of G-RAM use
- History of G-RAM operations, investigations, remediations, and surveys
- Classification of an area as impacted or non-impacted by radiological operations
- Assessments of the likelihood of contamination migration
- Assessment of risk to human health and the environment
- Information useful to radiological scoping and characterization surveys
- Recommendations for future radiological investigations and remediation processes

The basic organization of the report is listed below. Individual tables and appendices are not included here but are listed in the Table of Contents. (Figures are presented after their first mention in the text of the HRA, tables are presented after their respective sections, and appendices are presented after Section 10.0.) Section 10.0 lists the reference documents used to prepare this HRA, but due to their number and length, the actual documents are provided separately on three compact discs.

3.0 SITE IDENTIFICATION AND DESCRIPTION

HPS is a former Navy shipyard located in the southeast portion of the City of San Francisco along the Bay (see Figure 3-1 below). This section details the geological and physical site characteristics and the current and historical information for HPS and immediately adjacent sensitive areas.

3.1 SITE DESCRIPTION

The Navy property known as HPS consists of approximately 936 acres, about half of which is submerged below the Bay. The base property also includes a 3.4-acre off-base property and railroad right-of-way. Adjacent to a residential area of San Francisco known as Bayview, entrance to the base is gained through the gate at the intersection of Innes Avenue and Donahue Street. Easily identifiable from a distance by its large gantry crane, HPS lies northeast across a narrow brackish water inlet from Candlestick Point, on the west bank of the Bay, south of the Oakland Bay Bridge.

For purposes of CERCLA, the base is referred to as:

Hunters Point Shipyard
San Francisco, California
EPA Region IX
CERCLA Information System (CERCLIS) Identification No. CA1170090087

A deep water, two drydock facility when purchased in 1939, the Navy augmented HPS to a full-service, ship repair and maintenance facility with numerous support buildings, utilities, four additional drydocks, an internal railroad, and living quarters. To support the expansion, the Navy quarried the nearby cliffs to create a working pad 12 to 15 feet above mean sea level (msl) by filling the Bay with quarried material. Refer to Appendix C, historic photographs and maps, Figures C1 through C11.

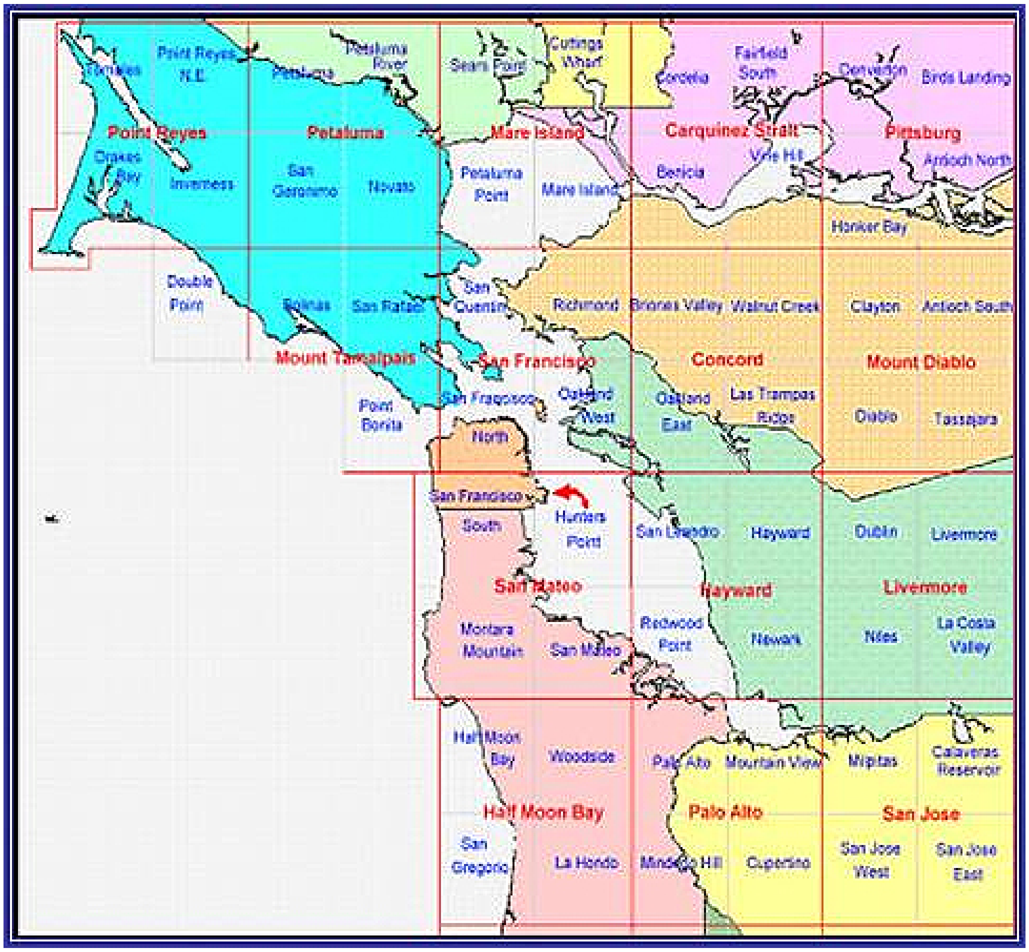


Figure 3-1. San Francisco Bay Area

3.2 GEOLOGICAL SETTING

The Bay was dry land during the ice ages when sea level dropped more than 300 feet as water accumulated in the great continental glaciers. The Sacramento River picked up several tributaries as it flowed through the coastal lowland, and then through the last mountain ridge in a deep canyon that is now the Golden Gate Strait. Coastal lowlands filled with water as sea level rose at the end of the last ice age. The Bay assumed its present form about 10,000 years ago, when sea level returned to its present stand.

Since the rising sea level flooded the Golden Gate Strait and converted the lower part of the river valley into what is now known as San Francisco Bay, the Sacramento and San Joaquin Rivers have been filling the Bay with sediment. This is because early mining operations in the

Sierra Nevada started billions of cubic yards of sediment moving down the rivers. More than a billion cubic yards of that sediment has now reached the Bay. It is estimated about 8 million cubic yards of sediment wash into the Bay every year.

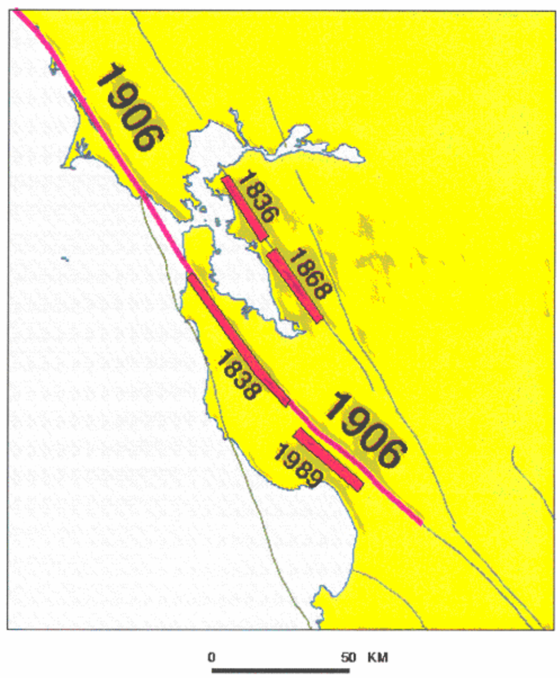
The Bay is about 55 miles long from north to south and 3 to 12 miles wide, an area of about 435 square miles. At its deepest part, the Bay is about 350 feet (58 fathoms) deep, but more than 80 percent is less than 12 feet (2 fathoms) deep. The Bay is made up of brackish water that is about 2.8 percent dissolved salts, 15 percent less than normal seawater, which flows in and out with the tides. An average cycle of rising and ebbing tide moves enough water through the Golden Gate Strait to flood about 1.25 million acres to a depth of 1 foot. Incoming currents reach speeds as great as 4 miles per hour; outgoing flow is much slower.

3.3 GEOLOGY

Geology is the scientific study of the origin, history, and structure of the earth, including the rocks that comprise and underlie the earth's surface features. In most areas, a coherent pattern emerges and geologists can understand the main events that brought the rocks to their present location and condition. However, this approach does not work well in the California Coast Range, where many of the rock formations do not make sense in the traditional way.

Coast Range bedrock beneath the shipyard consisting of sandstone and shale, chert (a flint-like quartz-bearing rock), greenstone (altered volcanic rock), and serpentinite has been assigned to the Franciscan Complex. The Franciscan Complex is one of the world's grandest assortments of rocks, deposited in seawater at many depths and in widely separated parts of the ocean. Rocks in one outcrop often seem unrelated to those in the next. In the late 1960s, geologists finally accepted that large parts of the Franciscan Complex are almost hopelessly scrambled. Geologists coined the term "melanges" to describe those chaotic jumbles of rock. The bedrock at HPS along the Bay margins is overlain with Bay mud deposits and exposed at the surface at some locations. Bay mud is capped with artificial fill that has been used to build the shipyard's working pad.

HPS lies between two major faults: the San Andreas, 7 miles southwest, and the Hayward, 10 miles to the northeast. Both of these fault systems are considered active and likely



- 1836 - Northern Hayward fault (M~6.8)
- 1838 - Peninsula Segment of the San Andreas (M~7)
- 1868 - Southern Hayward fault (M~7)
- 1906 - San Andreas fault (M7.7-7.9)
- 1989 - Loma Prieta (M7.0)

Figure 3-2. Significant Bay Area Earthquakes and Fault Lines

to experience a major event (Richter of magnitude 6.7 or greater) within the next 200 years. Another major fault, the Calaveras, lies about 20 miles to the east of HPS. Several lesser-known faults, including the San Bruno, Hillside, and City College, are within 5 miles of HPS. HPS is situated in a fault zone that can be expected to experience violent ground shaking and possible liquefaction of the fill material on which much of the shipyard was constructed during a large magnitude earthquake on any one of the surrounding faults. Figure 3-2 shows the location of active fault systems surrounding the HPS area.

Although no active faults are known to underlie HPS, earthquakes, by far, are the most probable uncontrollable natural hazard likely to strike the shipyard. During the Loma Prieta Earthquake on 17 October 1989, no boils or liquefaction were reported within HPS boundaries. However, the epicenter of the Loma Prieta Earthquake was much farther away from HPS than either the San Andreas or Hayward faults. Other natural phenomena such as high winds (hurricanes), tsunamis (long-period waves caused by underwater disturbances), seiches (seismic-induced waves in an enclosed body of water), and flooding are unlikely to seriously impact HPS.

3.4 HYDROLOGY

HPS straddles two of the seven San Francisco groundwater basins: the Islais Valley Groundwater Basin lies to the northeast and the South Groundwater Basin to the southwest.

The City and County of San Francisco supply the potable water that is used at HPS. Groundwater from HPS is not used for domestic purposes. There are no reports of operational wells within 1 mile of HPS. All operational wells at HPS are monitoring wells.

3.4.1 Groundwater at HPS

An A-aquifer, a B-aquifer, and one bedrock water-bearing zone have been identified at HPS. The A-aquifer is generally unconfined, consisting of artificial fill and Undifferentiated Upper Sand Deposits overlying Bay mud, and is unconfined and shallow with depths to groundwater ranging from 2 to 17 feet below ground surface (bgs). Recharge is from precipitation infiltration, Bay water, and possible leaks from water and storm drain lines.

An aquitard separates the A-aquifer from the B-aquifer, forming a vertical hydraulic barrier between the A- and B-aquifers and confining the B-aquifer to saturated, porous Undifferentiated Sedimentary Deposits lying between the aquitard and the bedrock water-bearing zone. Water in the A and B-aquifers generally flows toward the Bay.

Portions of saturated bedrock that are not in direct contact with the A- or B-aquifers are hydrostratigraphically classified as bedrock water-bearing zones. The direction of flow is uncertain due to the absence of continuity in the formation.

Groundwater within the shallow aquifer is unsuitable for use as a potable water supply.

3.4.2 Bay Dynamics

Tidal range at the Golden Gate Strait varies from plus 7 feet to minus 1.1 feet compared with msl. While Bay currents at the Golden Gate Strait reach 4 miles per hour, currents near HPS average less than 2 miles per hour. Winds seldom exceed 20 miles per hour and are predominantly a westerly onshore flow (blowing off the ocean from west to east).

The Sacramento and San Joaquin Rivers contribute about 90 percent of the estimated 750 billion cubic feet of inflow to the Bay. Other sources include the Petaluma, Guadalupe, and Napa Rivers; Alameda and San Lorenzo Creeks; and Coyote Creek, Redwood Creek, and San Francisquito Creek.

3.4.3 Climate and Meteorology

Moderately wet winters and dry summers characterize the Bay area, with rainfall averaging 19.71 inches per year predominantly from December to March. During rainy periods, mixing of air layers is high, resulting in lower pollution levels **(HRA-3010)**. Surface waters are either collected in subsurface storm drains or allowed to sheet flow into the Bay. Flood insurance rate maps published by the Federal Emergency Management Agency place HPS above the 100-year floodplain.

Temperatures in the HPS area are generally moderate, with average summer temperatures ranging from the low 50s to the high 70s °F and average winter temperatures ranging from the low 40s to the low 60s °F. A large-scale temperature gradient exists within the Bay area as a result of differential heating between land and water surfaces. This causes summer daytime temperatures 15 to 20 miles inland to be approximately 35 °F higher than shoreline areas. This differential decreases to less than 10 °F at night and reverses in the winter when the inland temperatures are sometimes 20 °F lower.

3.5 ADJACENT POPULATION

The 2000 Census reported 33,871,648 people in California, with more than 8.5 million residing in counties at least partially within a 50-mile radius of HPS. The metropolitan areas of San Francisco, Alameda, and Santa Clara Counties contain most of this population. The distribution of this population is shown in Table 3-1.

Residential, industrial, and commercial recreation areas surround HPS with the large Bayview/Hunters Point housing project situated immediately adjacent to the HPS entrance. Nearby industries include a variety of light industrial, commercial, and restaurant establishments. The population in cities within a 10-mile radius of HPS is shown in Table 3-2.

3.6 CURRENT AND FUTURE HPS USAGE

For over 20 years, the Navy has leased many HPS buildings to private tenants and Navy-related entities for industrial and artistic uses, including storage space, art studios, machine workshops, woodworking shops, automobile restoration garages, recreational vehicle parking, and filming of movies. Table 3-3 summarizes the identified buildings, structures, and open areas currently and formerly located at HPS, their former and current uses, and current tenants. Figure 3-3 shows the proposed future reuse of HPS.

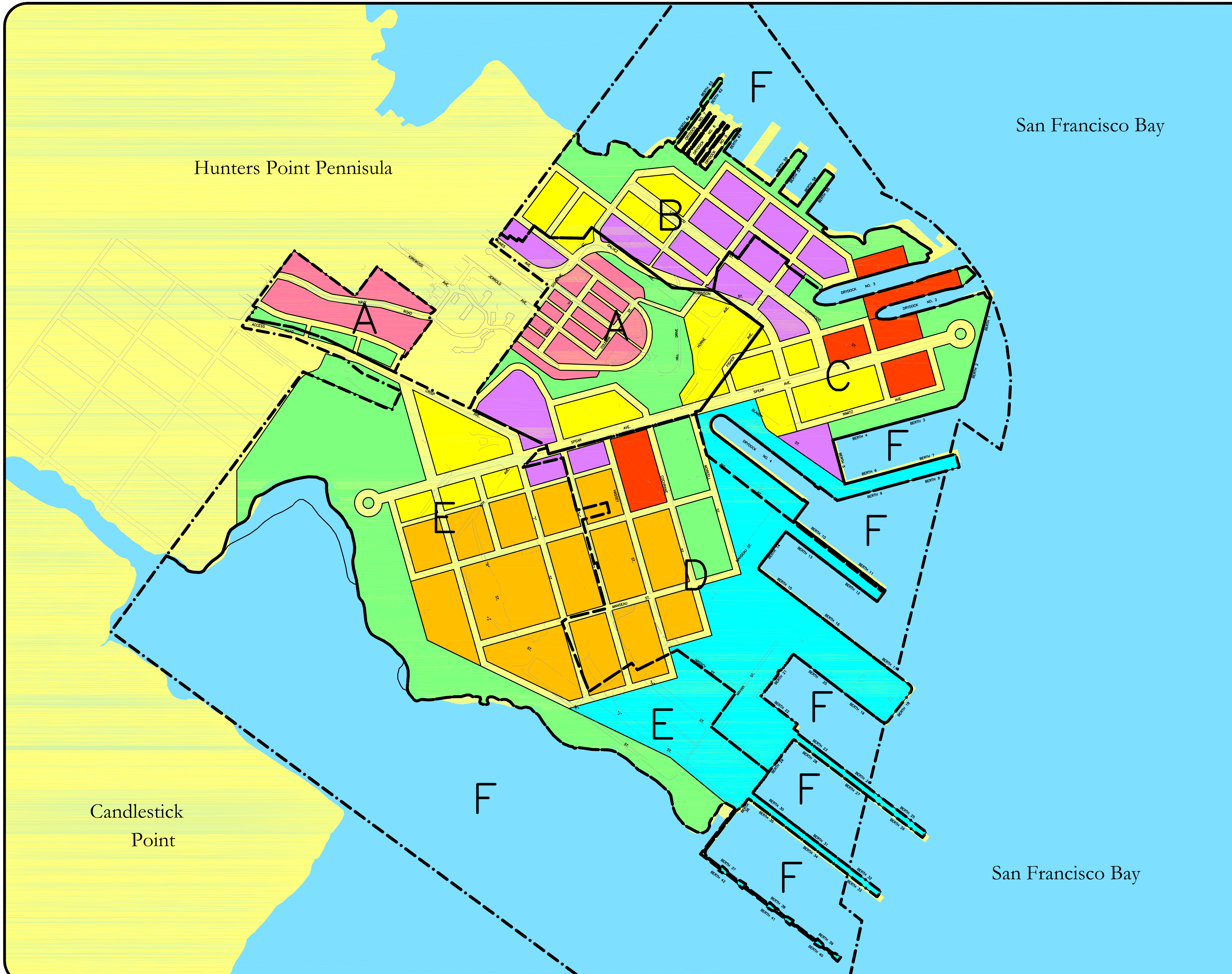
Only one private company currently uses licensed radioactive material at HPS. Building 113A (identified as 114 on the outside of the building) in Parcel B is used by Smith-Emery Company (Smith-Emery) to store moisture/density gauges containing small sources of radioactive materials. These portable gauges are used to test the in-place density and moisture content of compacted fill at construction sites. Smith-Emery maintains required records and monitors the radiation levels of shipping containers for the gauges.

Non-licensed radioactive material is in use at HPS in thoriated welding rods, building smoke detectors, and radiation survey instrument check sources used by remediation contractors.

3.7 ADJACENT LAND USAGE

Development of land surrounding the HPS site during the past 60 years has consisted of light and heavy industrial facilities, other shipyards, commercial fishing operations, and some residential dwellings. The rapid growth of the shipyard and its support facilities during WW II fueled the buildup of housing and commercial enterprises in the immediate vicinity of HPS to support the increased work force at the yard.

The San Francisco Housing Authority public housing, Hunters Point A-West, E-West, Hunters View, and Westbrook, are located in the immediate vicinity of HPS. These communities form a large housing area, part of which is adjacent to the HPS entrance gate. Other surrounding areas contain a mixture of light and heavy industries, including automobile recycling, repair shops, and food manufacturers. The Pacific Gas and Electric Company (PG&E) Hunters Point Power Plant, located near the HPS property, supplies electricity to the PG&E power grid, which includes HPS. Retail ventures, including stores and restaurants, are also located within 1 mile of HPS.



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800 0 800
Scale in Feet

Notes:

Shoreline data per Aerial Photography dated 10-01-86.

Sensitive Areas per City and County of San Francisco Redevelopment Agency 1997.

- Educational / Cultural
- Industrial
- Maritime - Industrial
- Mixed Use
- Open Space
- Research and Development
- Residential
- Parcel Boundary w/Designation

Hunters Point Naval Shipyard
San Francisco CA

Historical Radiological Assessment

January, 2004

New World Technology
448 Commerce Way, Livermore CA 94550
Phone (925) 443-7967 Fax (925) 443-0119

SAGE Consultants, Inc.

Figure 3.3
Proposed Land Use

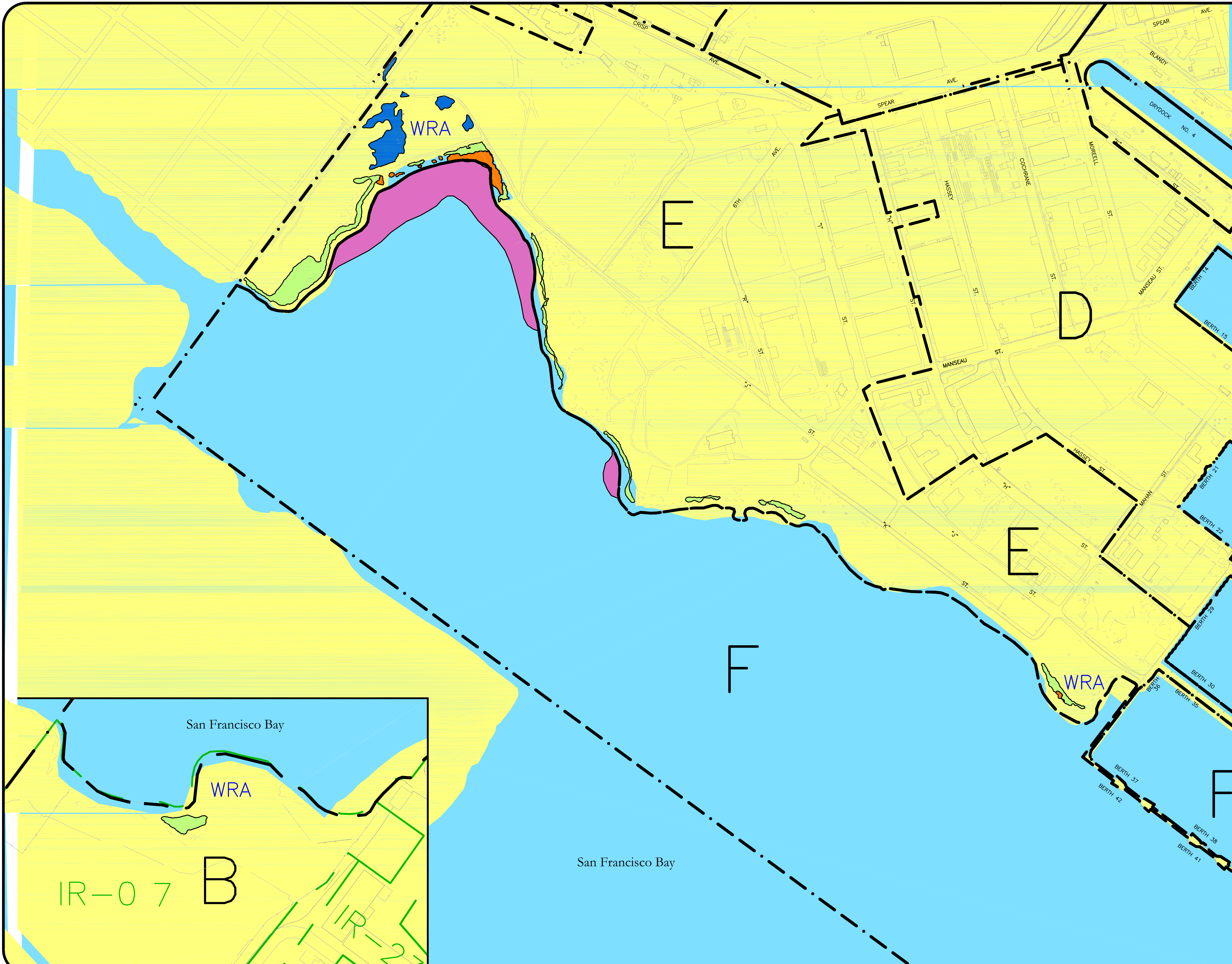
3.8 ENVIRONMENTALLY SENSITIVE AREAS

Environmentally sensitive areas are located on and in the vicinity of HPS. Table 3-4 lists the schools located within 1 mile of HPS and the reported age ranges of the students. Other sensitive areas, including wetlands, intertidal salt marshes, and mudflats, are present at HPS **(HRA-3010)**.

Two types of wetland habitat, saline emergent wetland (coastal salt marsh) and small seasonal freshwater wetland, are found in the several small wetland areas along the undeveloped southern HPS shoreline in Parcel E. These areas provide the greatest ecological diversity of any habitat at HPS. Several small areas of saline emergent wetland are located within the intertidal zone along the Bay shoreline edges. Plant species observed in these areas during a February 1997 field survey included pickleweed (*Salicornia virginica*), salt grass (*Distichlis spicata*), and cordgrass (*spartina foliosa*) **(HRA-3010)**.

A small freshwater emergent wetland area, supported by a small intermittent freshwater source, is located on approximately 1 acre in IR Site 01/21 (IR-01/21) (Figure 3-4). Observed plant species in this wetland include the toad rush (*Juncus sp.*), umbrella sedge (*Cyperus laevigatus*), Pacific coast bulrush (*Scirpus robustus*), and rabbit's-foot grass (*Polypogon monspeliensis*) **(HRA-3010)**.

Waterfowl, shorebirds, and wading birds may use wetland habitats as a source of food, cover, and water. The following animal species were observed at HPS during the February 1997 field survey: the common snipe (*Gallinago gallinago*), greater yellowlegs (*Tringa melanoleuca*), killdeer (*Charadrius vociferus*), mallard (*Anas platyrhynchos*), great blue heron (*Ardea herodias*), and great egret (*Casmerodius albus*). The abundance of shorebirds may serve as prey for raptors, such as the endangered peregrine falcon (*Falco peregrinus*). Small animals, such as the raccoon (*Procyon lotor*), opossum (*Didelphis virginiana*) and the burrowing owl (*Athene cunicularia*), may forage in or along the edges of wetland habitat. Harbor seals (*Phoca vitulina richardsi)* are known to feed in the waters off HPS **(HRA-3010)**.



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Scale in Feet

Notes:

Shoreline data per Aerial Photography dated 10-01-86.

Sensitive Areas per City and County of San Francisco Redevelopment Agency 1997.

Emergent Wetland

Freshwater Wetland

Intertidal Salt Marsh

Mudflat

Parcel Boundary w/Designation

WRA Possible Wetland Restoration Area

Hunters Point Naval Shipyard
San Francisco CA

Historical Radiological Assessment

January, 2004

New World Technology
448 Commerce Way, Livermore CA 94550
Phone (925) 443-7967 Fax (925) 443-0119

SAGE Consultants, Inc.
1978 Ventura Blvd., CAMARILLO CA 93010-7847
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www.sagecon.com

Figure 3.4
Environmental Sensitive Areas

The mudflats at HPS, located in South Basin and India Basin, occupy the intertidal zone that is exposed at low tide and provide a habitat for many invertebrates, including oligochaetes, polychaetes, crustaceans, decapods, isopods, gastropods, and bivalves. These invertebrates are preyed upon by shorebird species that forage exclusively at low tide, such as the western sandpiper (*Calidris mauri*), willet (*Catoptrophorus semipalmatus*), sanderling (*Calidris alba*), and dunlin (*Calidris alpina*). Shorebirds eat a variety of invertebrate prey usually obtained from the top few centimeters of the substrate or, less often, from the water column overlying the substrate. Stomach contents research has shown that the gem clam (*Gemma gemma*), polychaete worm (*Neanthes succinea*), and mud snail (*Ilyanassa obsoleta*) are common prey for many shorebirds. Fish, such as the silver surfperch (*Hyperprosopon ellipticum*), cheekspot goby (*Ilypnus gilberti*), and white croaker (*Genyonemus lineatas*), prey upon these invertebrates at high tide **(HRA-3010)**.

SECTION 3
TABLES

TABLE 3-1
POPULATION OF COUNTIES ALL OR PARTIALLY WITHIN A 50-MILE RADIUS OF HPS

County	1990 Population	2000 Population
Alameda	1,279,182	1,443,741
Contra Costa	803,731	948,816
Marin	230,096	247,289
Napa*	110,765	124,279
Sacramento*	1,041,219	1,223,499
San Joaquin*	480,628	563,598
San Francisco	723,959	776,733
San Mateo	649,623	707,161
Solano*	340,421	394,542
Sonoma*	388,322	458,614
Santa Clara*	1,497,577	1,682,585
Santa Cruz	229,734	255,602
TOTAL POPULATION	7,775,257	8,826,459

**Only portions of the county are within a 50-mile radius of HPS*

**TABLE 3-2
POPULATION OF CITIES WITHIN
A 10-MILE RADIUS OF HPS**

City	1990 Population	2000 Population
Alameda City	76,459	72,259
Burlingame	26,801	28,158
Daly City	92,311	103,621
Millbrae	20,412	20,718
Oakland	372,242	399,484
Pacifica	37,670	38,390
Piedmont	10,602	10,952
San Bruno	38,961	40,165
San Francisco	732,959	776,733
South San Francisco	54,312	60,552
TOTAL POPULATION	1,462,729	1,551,032

**TABLE 3-3
CURRENT AND FORMER FACILITIES AT HPS
BY BUILDING NUMBER**

Building/ Site No.	Parcel	Former Uses	Current Status
18-19	A	24 Apartment Houses (Solomon's Village)	Not occupied
100	A	Main Electrical Substation for Navy Power	In use
101	A	Administration Building, Civilian Cafeteria, and Blueprint Shop	Leased by San Francisco Redevelopment Authority – The Point (Artists)
102	A	Personnel Building, Office of Naval Research, Security, Administration (Industrial Relations), and Post Office	Not occupied
106	A	Watch Tower, Gatehouse	Demolished
110	A	Marine Barracks	Leased by San Francisco Redevelopment Authority – The Point (Aleta Childs and Eclectic Cookery)
151	A	Bus Shelter – E. of #102, Personnel Shelter	Demolished
158	A	Sentry House and Main Gate	Used by Navy as Sentry House, Main Gate
322	A	Marine Guard and Pass Office, Office Space, NRDL Instrumentation Laboratory	Not occupied
801	A	Public Works Storage Building	Demolished
805	A	Guard Shelter – Crisp Avenue, Personnel Shelter	Demolished
808	A	Heavy Material Storage Building, Industrial Storage, and General Warehouse	Leased to Precision Transport for copier paper and toner cartridge distribution center.
813	A	Supply Storehouse, General Warehouse, and Disaster Control Center	Not occupied
814	A	Furniture Storage	Demolished
816	A	High-Voltage Accelerator and Van de Graaff Accelerator	Not occupied
817	A	Sentry House, South Gate	Demolished
817A	A	Sentry House, outside South Gate	Demolished
818	A	Water Treatment Plant	Not occupied
819	A	Sewage Pumping Station	In use
821	A	X-ray Laboratory	Not occupied
822	A	Sentry House – South Gate	Demolished
823	A	Standby Generator Bldg	Not occupied

TABLE 3-3
CURRENT AND FORMER FACILITIES AT HPS
BY BUILDING NUMBER

Building/ Site No.	Parcel	Former Uses	Current Status
901	A	Officers' Mess Building, Officers' Club (Open), and Rental Housing	Not occupied
904	A	Green House – Glass	Demolished
905	A	Green House – Lath	Demolished
906	A	Gardener's Tool House	Demolished
907	A	Garages – 5 cars	Not occupied
908	A	Garages – 8 cars	Not occupied
909	A	Garages – 2 cars	Not occupied
914	A	Guard Shelter – Innes Avenue	Unknown
915	A	Bank Building	Used by San Francisco Redevelopment Agency as offices
916	A	Chief Petty Officers' Club and Package Liquor Store	Dago Mary's Restaurant
917	A	Grocery Store	Demolished
918	A	Detached Garage	Not occupied
919	A	Detached Garage	Demolished
920	A	Detached Garage	Not occupied
921	A	Bachelor Officer Quarters	Not occupied
A to O	A	17 Officers' Quarters	Not occupied
E	A	Residence	Leased by San Francisco Redevelopment Agency
IR-19	A	Officers Club (Building 901)	Under CERCLA investigation
IR-41	A	Building 816 And 818	Under CERCLA investigation
IR-43	A	Gardening Tool House (Building 906)	Under CERCLA investigation
IR-59	A	Parcel A Groundwater Investigation	Under CERCLA investigation
IR-59JAI	A	Parcel A Jerrold Avenue Investigation	Under CERCLA investigation
IR-77	A	UST Site S-812 at Building 813	Under CERCLA investigation
R	A	Residence	Not occupied
R-3 to R-119	A	26 Civilian Quarters	Unknown
S – Z	A	Residence	Not occupied
S-101	A	Ship Repair Graving Drydock	Not used
S-137	A	Flagpole	Unknown
S-152	A	Retaining Wall (4 feet to 7 feet high)	Unknown

**TABLE 3-3
CURRENT AND FORMER FACILITIES AT HPS
BY BUILDING NUMBER**

Building/ Site No.	Parcel	Former Uses	Current Status
S-807	A	Small Arms Magazine (Near Building 813)	Unknown
S-813	A	Retaining Wall (Back of Building 813, 300 feet long, 30 feet high)	Unknown
S-814	A	Retaining Wall (Near South Gate, 167 feet long, 15 feet, 3 inches high)	Unknown
S-815	A	Substation “F” (no transformers)	Unknown
S-901	A	Water Storage Tank, Potable	Unknown
20-24	B	Apartments	Demolished
27	B	Clocking Station	Not occupied
103	B	Submarine Barracks and CROSSROADS Personnel Decontamination Center	Leased by San Francisco Redevelopment Agency – The Point (Artists)
104	B	Naval Reserve Armory	Leased by San Francisco Redevelopment Agency – The Point (Artists)
105	B	Watch Tower, Gatehouse	Demolished
107	B	Design Division Allowance Section and Design Branch Damage Control	Demolished
108	B	Temporary Marine Barracks and Electronics	Demolished
109	B	Police Station	Leased by San Francisco Police Department
113	B	Torpedo Storage and Overhaul Building, Naval Research, Tug Maintenance, Salvage Divers’ Facility, and Sample Storage from Bikini	Used by San Francisco Police Department for storage
113A	B	Torpedo Storage Building, NDT Facility (Radiography), Number Changed to 114	Leased to Smith Emery
114	B	Submarine Barracks, Design Branch, Technical Library, and Administrative Building (Design Annex)	Demolished
115	B	Submarine Training School and Applied Instruction Building	Leased by Finishworks for woodworking shop and work studios
116	B	Submarine Subsistence, Drill Hall, Applied Instruction Building, and Submarine Applied Training School	Leased by Julian and Louise Billotte
117	B	Submarine Barracks	Leased by San Francisco Redevelopment Agency – The Point (Artists)
118	B	Submarine Bachelor Officers’ Quarters and Administration Building	Demolished
119	B	Medical Stores and Temporary Training School and Infirmary	Demolished

TABLE 3-3
CURRENT AND FORMER FACILITIES AT HPS
BY BUILDING NUMBER

Building/ Site No.	Parcel	Former Uses	Current Status
120	B	Submarine Recreation Center and Enlisted Men's Club	Used as Police Athletic Club
121	B	Submarine Offices, Apprentice School, Submarine Repair Shop, Administration Building, and Civil Service Training Center	Not occupied
122	B	Substation "V" and Compressed Air Plant	Not occupied
123	B	Battery Overhaul and Storage Building and Substation "T"	Not occupied
125	B	Submarine Base Cafeteria and Civilian Cafeteria-Restaurant	Leased to Bridenthal Cabinetry for cabinet making, workshop, offices, and storage
127	B	Latrine	Unknown
128	B	Shop Services, Work Control Centers No. 1, and Ship Repair Shop	City and County of San Francisco DEA Warehouse
129	B	Submarine Pier Office, Administration Building, and Substation "U-2"	Not occupied
130	B	Pipefitters' Shop, Ship Repair Shop, Machine Shop, Metal Working Shop, and LLRW Waste Storage	Not occupied, Environmental Hazmat Storage
131	B	Substation "U"	Not occupied
132	B	Submarine Pier Office, Enlisted Men's Barracks without Mess, and Substation "U-1"	Not occupied
133	B	Latrine	Not occupied
140	B	Pump House Drydock 3	Not occupied
141	B	Dock Shipwrights' Shop	Not occupied
142	B	Air Raid Shelter "A", Personnel Shelter, and Sample Counting Room for CROSSROADS Samples	Demolished
143	B	Joiner/Carpenter Shop (Drydock 3)	Demolished
144	B	Latrine	Not occupied
145	B	Saltwater Pumphouse	Demolished
146	B	Industrial and Photo Laboratory, Industrial Storage Electronics, LLRW Storage, and Radiography	Not occupied
147	B	Temporary Ships Connections Building	Demolished
148	B	Duty Section – Submarine Crews	Unknown
149	B	Duty Section – Submarine Crews	Demolished
150	B	Bus Shelter – King Avenue, Personnel Shelter	Not occupied

**TABLE 3-3
CURRENT AND FORMER FACILITIES AT HPS
BY BUILDING NUMBER**

Building/ Site No.	Parcel	Former Uses	Current Status
152	B	Bus Shelter – Robinson Street, Personnel Shelter	Demolished
155	B	Area Time Office No. 2, Administration Building	Demolished
156	B	Rubber Shop	Not occupied
157	B	Shipyard Industrial Laboratory NDT, Sound Laboratory, Testing Center for Metals (radiography), and Metal Shop	Not occupied
159	B	Latrine	Not occupied
161	B	Maintenance Service Center	Demolished
162	B	Paint Storage	Demolished
163	B	Rubber Shop Annex	Not occupied
Drydock 5	B	Ship repair (submarine)	Not used
Drydock 6	B	Ship repair (submarine), Drydock Operations for NNPP, and Decontamination Drydock for OPERATION CROSSROADS	Not used
Drydock 7	B	Ship Repair (submarine)	Not used
IR-07	B	Sub-Base Area	Under CERCLA investigation
IR-10	B	Battery and Electroplating Shop (Building 123)	Under CERCLA investigation
IR-18	B	Waste Oil Disposal Area	Under CERCLA investigation
IR-20	B	Rubber Shop (Building 158)	Under CERCLA investigation
IR-23	B	Buildings 145,148,161, and 182	Under CERCLA investigation
IR-24	B	Building 124, 125, 128, and 130	Under CERCLA investigation
IR-26	B	Nondestructive Testing Lab (Building 157 and Area North of Drydock 3)	Under CERCLA investigation
IR-31	B	Building 114	Under CERCLA investigation
IR-42	B	Building 109, 113, and 113A	Under CERCLA investigation
IR-60	B	Drydocks 5, 6, and 7	Under CERCLA investigation
IR-61	B	Substation V (Buildings122)	Under CERCLA investigation
IR-62	B	Submarine Training (Building 115 and 116)	Under CERCLA investigation
S-107	B	Ship Repair Graving Drydock	Not used
S-108	B	Ship Repair Graving Drydock	Not used
S-109	B	Ship Repair Graving Drydock	Not used
S-112	B	Retaining Wall (7 feet high)	Unknown
S-113	B	Retaining Wall (2.5 feet to 10 feet high)	Unknown

TABLE 3-3
CURRENT AND FORMER FACILITIES AT HPS
BY BUILDING NUMBER

Building/ Site No.	Parcel	Former Uses	Current Status
S-146	B	Sulphuric Acid Tank	Demolished
S-148	B	Distilled Water Tank	Unknown
S-148	B	3 Dolphins for small boats	Unknown
S-151	B	Retaining Wall (4 feet high)	Unknown
S-153	B	Substation “U-1”	Unknown
S-154	B	Substation “U-2”	Unknown
S-156	B	Substation	Not Occupied
S-157	B	Playing Court	Unknown
34	C	Clocking Station 34	Not occupied
72	C	Clocking Station 72	Not occupied
111	C	Lubricating Oil Pumphouse	Demolished
112	C	Diesel Oil Pumphouse	Demolished
124	C	Acid Mixing Plant	Unknown
126	C	Submarine Pier Office	Unknown
134	C	Outside Machine and Service Shops, Ship Repair Shop, Quality and Reliability Assurance Offices, and Central Tool Room	Not occupied
135	C	Substation “G”	Not occupied
154	C	Area Time Office No. 1 and Administration Building	Not occupied
201	C	Tugmaster’s Office and Administration Building	Demolished
203	C	Power House, Oil Fired Heating Plant, Substation “H”, and CROSSROADS Ship Fuel Burn	Not Occupied
204	C	Saltwater Pumphouse and Fire Protection Pumping Station	Not occupied
205	C	Pumps Drydock 2, Boilers and Compressors, and Compressed Air Plant	Not occupied
206	C	Substation “A” and Compressors, Compressed Air Plant	Not occupied
207	C	Latrine	Not occupied
208	C	Shop Service Building and Tug Spare Parts	Not occupied
210	C	Dispensary	Demolished
211	C	Machinery and Electrical Test and Repairs Welding Shop and LLRW Storage Site	Not occupied

TABLE 3-3
CURRENT AND FORMER FACILITIES AT HPS
BY BUILDING NUMBER

Building/ Site No.	Parcel	Former Uses	Current Status
214	C	Radiography, Combat Weapons Systems Office, Administrative Annex, Accounting and Bond Office, Accounting, Triple A Office Space, and NRDL Health Physics Counting Room	Not occupied
215	C	Firehouse	Navy uses as Firehouse
217	C	Sheetmetal Shop and Ship Repair Shop	Not occupied
218	C	Latrine	Not occupied
219	C	Substation “E”	Not occupied
224	C	Bomb Shelter, Air Raid Shelter, and OPERATION CROSSROADS Sample Storage	Not occupied
225	C	Shop Service Building, Work Control Center 2, and Administration Building	Not occupied
226	C	Latrine	Not occupied
228	C	Central Cafeteria and Civilian Cafeteria	Not occupied
229	C	Substation “L”	Not occupied
230	C	Shop Service Building and Machine Shop	Not occupied
231	C	Inside Machinists Shop and Ship Repair Shop	Not occupied
232	C	Bus Shelter – Fisher and Van Keuren	Demolished
234	C	Latrine, Ship Superintendent Office and Administration Building	Not occupied
235	C	Shop 38 Central Tool Room Annex and General Warehouse	Demolished
236	C	Saltwater Pumphouse	Leased – Astoria Metals Corp.
238	C	Unknown	Demolished
241	C	Forge Shop and Ship Repair Shop	Not occupied
251	C	Electricians’ Shop, Storage and Issue, Temporary Ships Service, Central Tool Room, and Industrial Relations	Not occupied
252	C	Bus Terminal and Golden Anchor Coffee Shop	Not occupied
253	C	Maritime Administration Ships Parts Storage ('94), Electronics, Optical and Ordnance Shops, Radiography, Weapons Shop, Electronics Shop, RADIAC Instrument Calibration Laboratory, and Storage of Parts from OPERATION CROSSROADS ships; Probable Location of Radium Paint Activities	Not occupied

TABLE 3-3
CURRENT AND FORMER FACILITIES AT HPS
BY BUILDING NUMBER

Building/ Site No.	Parcel	Former Uses	Current Status
254	C	Refuel Station	Not occupied
257	C	Galvanizing Plant	Unknown
258	C	Pipefitters Shop	Not occupied
270	C	Paint Shop, Temporary Ship Service Connection and Ship Repair Shop	Not occupied
271	C	Equipment Storage/Barge Services Office, Paint Shop Annex, Sandblast Facility, Paint Laboratory, and General Shops	Not occupied
272	C	Shop Service Group, S-64, 71, 72, 99, Riggers tooling, storage & issue, offices, Riggers & laborers shop, possibly radiography	Leased by Carpenter Rigging and Ermico Enterprises for offices, workshop, and storage
273	C	Substation “GH-2”	Not occupied
275	C	Sheet Metal Annex	Not occupied
276	C	Portable Substation “Z-1”	Unknown
277	C	Portable Substation “Z-2”	Demolished
278	C	Storage	Demolished
279	C	Sheet Metal Racks	Demolished
280	C	Work Area, Sheet Metal	Not occupied
281	C	Electronics, Weapons, and Precision Building	Not occupied
282	C	Antenna Abrasive Cleaning Unit	Not occupied
300	C	Substation “N”	Astoria Metals has access to the building for electrical service
301	C	Latrine	Leased by Astoria Metals for men’s showers and locker rooms
367	C	Administration Building (Field Office)	Leased by Astoria Metals for field office
425	C	Area Time Office No. 5 and Administration Building	Demolished
Drydock 2	C	Drydock, OPERATION CROSSROADS Ship Decontamination, YAG Decontamination, and Possible Removal of Radium Devices from Ships	Not used
Drydock 3	C	Drydock, OPERATION CROSSROADS Ship Decontamination, and Possible Removal of Radium Devices from Ships	Not used
Drydock 4	C	Drydock, OPERATION CROSSROADS Ship Decontamination, And Possible Removal of Radium Devices from Ships	Not used
GH1	C	Substation GH1 and Building 258	Not occupied
IR-06	C	Tank Farm	Under CERCLA investigation

TABLE 3-3
CURRENT AND FORMER FACILITIES AT HPS
BY BUILDING NUMBER

Building/ Site No.	Parcel	Former Uses	Current Status
IR-25	C	Machine Shop (Building 134)	Under CERCLA investigation
IR-27	C	Pump and Compressor Plan (Building 205)	Under CERCLA investigation
IR-28	C	Buildings 211/253, 219, 229, 230, 231, 258, 270, 271, 273, and 281	Under CERCLA investigation
IR-29	C	Buildings 203, 217, 275, 279, 280 and 282	Under CERCLA investigation
IR-30	C	Forge Shop (Building 241)	Under CERCLA investigation
IR-57	C	Drydock 4 Area	Under CERCLA investigation
IR-58	C	Scrap Yard North of Building 258	Under CERCLA investigation
IR-63	C	Former Building 278	Under CERCLA investigation
IR-64	C	Substation A (Building 208)	Under CERCLA investigation
M	C	Substation M, North Pier	Not Occupied
Q	C	Substation Q Building 281	Not occupied
S-117	C	Diesel Oil Storage and Distribution System	Not used
S-118	C	Diesel Oil Storage and Distribution System	Not used
S-119	C	Diesel Oil Storage and Distribution System	Not used
S-120	C	Diesel Oil Storage and Distribution System	Not used
S-121	C	Diesel Oil Storage and Distribution System	Not used
S-122	C	Diesel Oil Storage and Distribution System	Not used
S-123	C	Diesel Oil Storage and Distribution System	Not used
S-124	C	Diesel Oil Storage and Distribution System	Not used
S-125	C	Diesel Oil Storage and Distribution System	Not used
S-126	C	Diesel Oil Storage and Distribution System	Not used
S-127	C	Diesel Oil Storage and Distribution System	Not used
S-128	C	Diesel Oil Storage and Distribution System	Not used
S-129	C	Diesel Oil Storage and Distribution System	Not used
S-130	C	Diesel Oil Storage and Distribution System	Not used
S-131	C	Diesel Oil Storage and Distribution System	Not used
S-132	C	Diesel Oil Storage and Distribution System	Not used
S-133	C	Diesel Oil Storage and Distribution System	Not used
S-134	C	Diesel Oil Storage and Distribution System	Not used

TABLE 3-3
CURRENT AND FORMER FACILITIES AT HPS
BY BUILDING NUMBER

Building/ Site No.	Parcel	Former Uses	Current Status
S-147	C	Distilled Water Tank	Unknown
S-149	C	Electrolyte Tank	Unknown
S-150	C	Electrolyte Tank	Unknown
S-205	C	Berthing Quay Wall	Not Used
S-207	C	Ship Repair Graving Drydock	Not used
S-209	C	Fuel Oil Tank	Unknown
S-210	C	Brine Water Tank	Unknown
S-211	C	Fuel Oil Tank	Unknown
S-212	C	Fuel Oil Tank	Unknown
S-213	C	Water Storage Tank, Potable	Unknown
S-215	C	Paint Thinner Tank	Unknown
S-216	C	Substation “GH-3”	Unknown
S-217	C	Substation “M”	Unknown
S-218	C	Solvent Storage Tank	Unknown
S-219	C	Solvent Storage Tank	Unknown
274	D	Decontamination Training and Office Space	Not occupied
302	D	Transportation Shop and Automotive Vehicle Maintenance Facility	Leased by Golden Gat Railroad Museum for locomotive restoration area
302A-303	D	Transportation Shop Annex and Automotive Vehicle Maintenance Facility	Leased to HLA
304	D	Service Station	Not occupied
305	D	Storage Building	Demolished
306	D	Substation “I”	Used by Astoria Metals as substation
307	D	Public Works Equipment Storage, Electronic Storage, and Electronic Assembly	San Francisco Redevelopment Agency subleased to Wedrell, James and Sons for equipment storage
308	D	Saltwater Pumphouse and Fire Protection Pumping Station	Leased to Astoria Metals Corp.
308A	D	Saltwater pumphouse, addition, S-03	Leased to Astoria Metals Corp.
311	D	Latrine, Ship Superintendent’s Office, and Administration Building	Leased to Astoria Metals for unknown purpose
313	D	NRDL	Demolished

TABLE 3-3
CURRENT AND FORMER FACILITIES AT HPS
BY BUILDING NUMBER

Building/ Site No.	Parcel	Former Uses	Current Status
313A	D	RADIAC Instrument Development, Instrumentation Laboratory, and Laboratory Offices	Demolished
317	D	Temporary Animal Quarters for NRDL	Demolished
322	D	Unknown	Demolished
323	D	Boat Shop and Shore Activities Electronics	Leased by San Francisco Redevelopment Agency – The Point (Artists)
324	D	CO_2 Refilling Station	Not occupied
351	D	NRDL Annex E, Electronics Work Area, Machine Shop (on first floor), Engineering Division, Library, Chemical Technical Development Branch, Sampling Laboratory, General Research Laboratories, and Biological Research Laboratories	Not occupied
351A (352)	D	Instrument Repair Facility, Electronics Shop Annex, Meteorology Laboratory, Electronics Repair, Material Storage Area, Instrument Calibration, Radiography Shop, and Chemical Research Laboratory	Not occupied
360	D	Test Building	Not Occupied
363	D	Shipwrights and Joiners Shop and Ship Repair Shop	Leased to Quality Craftsman for workshop
364	D	Animal Irradiation Facility, Liquid Radioactive Waste Collection Facility, Research Animal Facility, Engineering Test Equipment, Hot Cell, General Research Laboratory, and Storage Building	Not occupied
365	D	Research Animal Facility, Shipyard Personnel Decontamination Center, NRDL Personnel Decontamination Center, and Storage Building	Not occupied
366	D	NRDL Electronics Work Area, Stock and Issue Section, Radiological Safety, Instruments Evaluation Section, Received Transfer of Administrative Functions from D-19, D-20, D-21, and 351, General Laboratories, Instrument Calibration, Radiography Shop, Chemical Research Laboratory, Boat/Plastic Shop, and Paint Activities	Leased by San Francisco Redevelopment Agency – The Point (Artists)
368	D	Ship Repair Shop and Pipefitting Shop	Not occupied
369	D	Ship Repair Shop and Rigging Shop	Not occupied

TABLE 3-3
CURRENT AND FORMER FACILITIES AT HPS
BY BUILDING NUMBER

Building/ Site No.	Parcel	Former Uses	Current Status
370	D	Latrine	Not occupied
371	D	Equipment Storage	Leased to S&W Productions for storage and scrap metal storage and to Circosta Iron and Metal
372	D	Prefab Decking Shelter	Leased to Astoria Metals for hazardous materials storage
373	D	Control Hut	Not occupied
374	D	Instrument Hut	Demolished
375	D	Control Hut	Demolished
376	D	Poseidon Control Hut	Demolished
377	D	Work Shop and Poseidon Systems Test Engineering	Demolished
378	D	Latrine	Not occupied
379	D	Instrumentation and Control and Poseidon Engineering	Not occupied
380	D	Poseidon Partial Full Scale Test Machine	Not occupied
381	D	Shock Test Facility	San Francisco Redevelopment Agency has subleased to Wedrell, James and Sons for offices and workshops
382	D	Poseidon Arresting Engine Shelter	Not occupied
383	D	Poseidon Shipping and Receiving Building	Caretaker Staff Offices
384	D	Poseidon Engineering	Fire Department
385	D	Poseidon Engineering	Caretaker Staff Offices
386	D	Storehouse and Caretaker Site Office	Caretaker Staff Offices
401	D	Building Trades Shop, Public Works Shop	Leased DiPaolo and Barbar, J. Heagy, P. Powers, San Francisco Redevelopment Authority – The Point and West Edge Design for art activities, workshop and storage
402	D	Supply Storehouse and General Warehouse	Leased to Body Works and Towing
403	D	Bus Shelter – Spear and "I" Streets, Personnel Shelter	Demolished
404	D	Supply Storehouse and General Warehouse	Leased to Mina Metal Corporation for workshop and manufacturing sheet metal products
407	D	Supply Storehouse, General Warehouse, and Ships Operational Activity Parts Office	Leased to American Van Lines for moving and storage operations
408	D	Furnace Shelter	Not occupied
409	D	Welder Motor Generator Building	Not occupied
410	D	Welder Motor Generator Building	Leased West Edge Designs

TABLE 3-3
CURRENT AND FORMER FACILITIES AT HPS
BY BUILDING NUMBER

Building/ Site No.	Parcel	Former Uses	Current Status
411	D	Shipfitters and Boilermakers Shop, Ship Repair Shop, Civilian Cafeteria, and Radiography	Leased to Sierra Western Equipment, Eric Lansdown, Christian Engineering and Circosta Iron & Metals for workshop, storage, and offices
412	D	Railroad Scales Building	Leased Golden Gate Railroad Museum
415	D	Supply Storehouse, Landing Vehicle Tracked Supply, and General Warehouse	Not occupied
416	D	Supply Storehouse, Landing Vehicle Tracked Supply, and General Warehouse	Not occupied
417	D	Acetylene Manifolding Building and Welding Engineers	Leased to Hydro-Chem for storage
418	D	Metal Spray Building, Ship Repair Shop, and Quality and Reliability Assurance Welding Engineering Facility	Leased to Hydro-Chem for offices and workshop
419	D	Oxygen Converter Building	Not occupied
420	D	Oxygen Cylinder Charging Building	Not occupied
421	D	Oxygen Control Building	Not occupied
422	D	Latrine, Administration Building	Demolished
423	D	Compressor Building	Demolished
424	D	Area Time Office No. 4 and Administration Building	Leased to Hydro-Chem for storage, laundry, and showers
428	D	Unknown	Demolished
432	D	Temporary Ordnance Storage, Supply Storehouse, and General Warehouse	Demolished
433	D	Temporary Ordnance Storage, Supply Storehouse, and General Warehouse	Demolished
434	D	Supply Storehouse, Landing Vehicle Tracked Supply, and General Warehouse	Demolished
435	D	General Warehouse and Equipment Storage	Leased by San Francisco Redevelopment Agency – The Point (Artists)
436	D	General Warehouse and Material Storage	Not occupied
437	D	General Warehouse and Pipe Storage	Not occupied
438	D	Metal Spray Shelter (Portable)	Not occupied
439	D	Equipment Storage	Ermico & Young Lab
500	D	Barracks, Ships BOQ, and NRDL Administrative Offices	Not occupied
501	D	Ships Barracks and Teen Club	Demolished

TABLE 3-3
CURRENT AND FORMER FACILITIES AT HPS
BY BUILDING NUMBER

Building/ Site No.	Parcel	Former Uses	Current Status
502	D	Ships Barracks	Demolished
503	D	Navy Exchange, Launderette, Small Stores, Ships Subsistence and Laundry, Small Animal Exposure Facility, and Radioactive Laundry Facility	Demolished
504	D	Laundry Office	Unknown
505	D	Navy Exchange, Bowling Alley, Gymnasium, Ships Canteen, and NRDL Annex	Not occupied
519	D	Temporary Chapel and Chapel	Demolished
522	D	Bus Shelter – Third and “H” Streets and Personnel Shelter	Demolished
523	D	Saltwater Pumphouse and Fire Protection Pumping Station	Not occupied
525	D	Pacific Reserve Fleet Supply Building and General Warehouse	Not occupied
526	D	Pacific Reserve Fleet Repair Shop and General Warehouse	Not occupied
530	D	Hobby Shop and Automotive Hobby Shop	Not occupied
606	D	Shore Intermediate Maintenance Facility	San Francisco Redevelopment Agency has subleased to San Francisco Police Department for police staging area, offices, and vehicle storage
Gun Mole Pier	D	Ship Regunning Pier	Unused
IR-08	D	PCB Spill Area at Former Building 503	Under CERCLA investigation
IR-09	D	Pickling and Plate Yard	Under CERCLA investigation
IR-16	D	Container Storage Site	Under CERCLA investigation
IR-17	D	Drum Storage and Disposal Site	Under CERCLA investigation
IR-22	D	Shop Service Buildings 368 and 369	Under CERCLA investigation
IR-32	D	Regunning Pier and Building 383	Under CERCLA investigation
IR-33	D	Buildings 118, 125, 302, 302A, 304, 364, 411, 417, 418, and 424	Under CERCLA investigation
IR-34	D	Buildings 351 and 388	Under CERCLA investigation
IR-35	D	Buildings 274, 308, 313, 313A, 322, 372 and the area bounded by Manseau, Morrell, and “E” Street	Under CERCLA investigation
IR-37	D	Buildings 401, 423, 435, 436, and 437	Under CERCLA investigation
IR-44	D	Area Near Buildings 408, 409, 410, and 438	Under CERCLA investigation
IR-53	D	Buildings 525 and 530	Under CERCLA investigation
IR-55	D	Buildings 307 and Surrounding Area	Under CERCLA investigation
IR-65	D	Carbon Dioxide Refilling Station (Building 324)	Under CERCLA investigation

TABLE 3-3
CURRENT AND FORMER FACILITIES AT HPS
BY BUILDING NUMBER

Building/ Site No.	Parcel	Former Uses	Current Status
IR-66	D	Office and Storehouse (Building 407)	Under CERCLA investigation
IR-67	D	Sheet Metal Shop (Building 430)	Under CERCLA investigation
IR-68	D	Area North of Building 378	Under CERCLA investigation
IR-69	D	Building 523 and Associated Metal Shed	Under CERCLA investigation
IR-70	D	Area Northeast of Building S-308	Under CERCLA investigation
IR-71	D	Crane Yard	Under CERCLA investigation
NRDL Site on Mahan Street	D	Demolished NRDL Building	Demolished
QA	D	QA Office	Not occupied
S-301	D	Repair Pier	Not used
S-302	D	Repair Pier	Not used
S-303	D	Fixed Crane Structure	Not used
S-304	D	Vehicle Ready Fuel Storage Tank	Unknown
S-305	D	Vehicle Ready Fuel Storage Tank	Unknown
S-306	D	Substation “I-7”	Unknown
S-307	D	Drydock 4 Pumping Plant and Substation “R”	Unknown
S-308	D	Playing Field and Facilities (Softball Diamond No. 1)	Unknown
S-309	D	Playing Field and Facilities (Softball Diamond No. 2)	Unknown
S-410	D	Pickling Plant (Building 411 Plate Yard)	Unknown
S-411	D	Acid Storage Tank (Building 411 Plate Yard)	Unknown
S-412	D	Scales, Railroad and Truck	Unknown
S-413	D	Substation “I-1”	Unknown
S-415	D	Substation “I-6”	Unknown
S-417	D	Substation “O-1”	Unknown
S-501	D	Berthing Quay Walls	Not used
Y1	D	Substation	Not occupied
Building 402 Substation	D	Substation, Located at the Front Corner of Building 402,	Not occupied; all disconnected, substation unknown
Substation	D	Substation, N/a	In use
Building 378 Substation	D	Substation, next to Building 378	In use

TABLE 3-3
CURRENT AND FORMER FACILITIES AT HPS
BY BUILDING NUMBER

Building/ Site No.	Parcel	Former Uses	Current Status
IR-38	D/E	Building 500	Under CERCLA investigation
IR-39	D/E	Building 505	Under CERCLA investigation
309	E	Sandblast Plant Annex	Demolished
319	E	Sandblast Plant Annex	Demolished
400	E	Supply Storehouse, Receiving Storehouse, and General Warehouse	Not occupied
404A	E	Supply Storehouse	Not occupied
405	E	Supply Storehouse and General Warehouse	Not occupied
406	E	Storehouse, Shipping and Packing, Warehouse (Central Receiving), Receipt and Shipping of NRDL Materials, and B&A Bodyworks and Towing	Not occupied
413	E	Cable Storage Building, Supply Storehouse, and General Warehouse	Leased to American Van Lines for moving and storage operations
414	E	LLRW Storage Area (PRC), Radium Storage Area (PRC), Public Works Furniture Storehouse, Supply Storehouse, and P.W. Warehouse	Navy Environmental Contractor - Shaw
506	E	Low Power Neutron Generator, Low Flux Neutron Laboratory, Biomedical Research, Chemical Technology Division, Nuclear and Physical Chemistry Branch, Instrument Storage, Animal Experimentation, Nuclear and Physical Chemistry, General Research Laboratories, and Radiochemistry Laboratory	Demolished
507	E	Public Works Offices, Health Services Division, Nucleonics, Animal Colony, Bio-Med Laboratory, Nucleonics Division, Personnel Branch, Photographic and Illustrating Section, Technical Library and Project Officers, Biological Research Laboratory, Decontamination and Contamination Studies, Animal Studies, and Laundry	Demolished
508	E	Barracks, Temporary Barracks, Photographic and Illustrating Section, Employee Relations, Health Physics Division, Facility Engineering Division, Office Services, NRDL Annex J, Administrative Offices, Technical Library, and Project Officers	Demolished

**TABLE 3-3
CURRENT AND FORMER FACILITIES AT HPS
BY BUILDING NUMBER**

Building/ Site No.	Parcel	Former Uses	Current Status
509	E	Enlisted Personnel and Disbursing Office and Library	Demolished
510	E	Training Facility 3/4 - Radiation Facility (NRDL) West Portion 1/4, Glassblowing Shop, Sample Storage (west end), Nucleonics Laboratory, Physics Branch, Physics Laboratories and Shops, and Warrant Officers Mess	Demolished
510A	E	Fire Research Facility, NRDL Designated Area, Radiological Samples from OPERATION CHEROKEE Moved from Building 815 for Storage, Radiation Facility, and Kevatron Facility	Demolished
511	E	Pacific Reserve Fleet Headquarters, San Francisco Group, and Administration Building (Surface Ship Training)	Demolished
511A	E	Pacific Reserve Fleet Material Shelter and Hobby Shop	Demolished
512	E	Ship Barracks without Mess	Demolished
513	E	Ship Barracks without Mess	Demolished
514	E	Ship Barracks without Mess	Demolished
515	E	Ship Barracks without Mess	Demolished
516	E	Ship Barracks without Mess	Demolished
517	E	NRDL Bio-Med Laboratory, Cobalt Radiation Facility, Animal Exposure Facility, General Research Laboratories, and Former Brig	Demolished
518	E	Motion Picture Theatre	Demolished
520	E	Dental Clinic, Pass Office, Thermal Radiation Division, Facility Engineering Division, NRDL Administrative Offices, Report Section, and Project Officers	Demolished
521	E	Power Plant, South Area; suspected of burning fuel oil from OPERATION CROSSROADS ships	Not occupied
524	E	Pacific Reserve Fleet Supply Building and General Warehouse	Demolished
527	E	Motor Generator Building Pier 2	Not occupied
528	E	Motor Generator Building Pier 3	Not occupied
529	E	NRDL Neutron Generator, Low Flux Neutron Laboratory, and Isotope Storage Vault	Demolished

TABLE 3-3
CURRENT AND FORMER FACILITIES AT HPS
BY BUILDING NUMBER

Building/ Site No.	Parcel	Former Uses	Current Status
531	E	General Warehouse	Demolished
600	E	Enlisted Men's Barracks	Not occupied
701	E	Storage Building; NRDL used for 120 days for storage of samples	Demolished
702	E	Supply Auxiliary Building and General Warehouse	Demolished
703	E	Salvage Office	Demolished
704	E	Storage Shelter, Transportation Shop Car, and Shelter Radioactive Material Storage Area	Leased Wagner Construction, Large Equipment Storage and Trucking Subtenant, terminated as of 6/30/03
705	E	Public Works Equipment Shelter	Demolished
707	E	Research Animal Facility used for Animal Breeding and Housing, and Waste Processing and Storage Facility	Not occupied
707B Site	E	Animal Colony	Demolished
707C Site	E	Nuclear Weapons Test Support	Demolished
708	E	Research Animal Facility, Bio-Med Facility, Animal Psychology Study Colony, and Biological Research Laboratory	Not occupied
709	E	Filling Station	Not occupied
710	E	Latrine	Demolished
803	E	Commissary Building	Demolished
807	E	Scrap Yard Processing Shed; potential for receiving scrap materials from ship decontamination and scrap containing Ra-226 bearing instruments and articles	Demolished
809	E	Lumber Storage Building and General Warehouse	Leased to Golden Gate Railroad Museum for locomotive storage and restoration area
810	E	LLRW and IDW Storage Location (PRC), Storehouse, Paint Activities, Paint and Oil Storage, and Warehouse	Not occupied, but possible use by Golden Gate Railroad Museum
811	E	Diesel Oil Platform	Demolished
812	E	Sandblast Plant	Demolished
Area Surrounding 500 Series Buildings	E	Location of Former RADLAB/NRDL Buildings	Demolished buildings and open space

TABLE 3-3
CURRENT AND FORMER FACILITIES AT HPS
BY BUILDING NUMBER

Building/ Site No.	Parcel	Former Uses	Current Status
Building 704 Animal Pens	E	Two Former Animal Pens	Removed
Building 704 Radioactive Materials Area	E	Location of Former Radioactive Materials Storage Area	Unoccupied
Building 707 Waste Triangle	E	NRDL Radioactive Waste Receiving	Unoccupied
E-1 to E-120	E	120 Homoja Huts	Demolished
Experimental Shielding Range	E	Experimental Shielding Range	Unused open land
IR-01	E	Industrial Landfill	Under CERCLA investigation
IR-02	E	Bay Fill	Under CERCLA investigation
IR-03	E	Oil Reclamation Ponds	Under CERCLA investigation
IR-04	E	Scrap Yard	Under CERCLA investigation
IR-05	E	Old Transformer Storage Yard	Under CERCLA investigation
IR-11	E	Power Plant Area (Building 521)	Under CERCLA investigation
IR-12	E	Disposal Trench Area	Under CERCLA investigation
IR-13	E	Old Commissary Area	Under CERCLA investigation
IR-14	E	Oily Liquid Waste Disposal Area	Under CERCLA investigation
IR-15	E	Oily Waste Ponds and Incineration Tank	Under CERCLA investigation
IR-21	E	Area Southwest of Building 801	Under CERCLA investigation
IR-36	E	Building 371, 400, 404A, 405, 406, 413, 414, 704, and 710	Under CERCLA investigation
IR-40	E	Building 527 and Pier 2	Under CERCLA investigation
IR-52	E	Railroad Right-of-Way (off site west of facility)	Under CERCLA investigation
IR-54	E	Building 511A	Under CERCLA investigation
IR-56	E	Railroad Yard and Track Southwest of Crisp Avenue	Under CERCLA investigation
IR-72	E	Building 810 Area	Under CERCLA investigation
IR-73	E	Asphalt Batch Plant	Under CERCLA investigation
IR-74	E	Building 815 (Formerly Used Defense Site)	Under CERCLA investigation
IR-75	E	Building 820 (Formerly Used Defense Site)	Under CERCLA investigation
IR-76	E	Area Surrounding Building 830 and 831 (FUDS)	Under CERCLA investigation

TABLE 3-3
CURRENT AND FORMER FACILITIES AT HPS
BY BUILDING NUMBER

Building/ Site No.	Parcel	Former Uses	Current Status
M-1 to M-17	E	17 Homoja Huts	Demolished
O-1 to O-38	E	38 Homoja Huts	Demolished
Parcel E Shoreline	E	Approximately 1.5 miles of shoreline along the Bay	Open land area bordering the Bay
S-414	E	Substation "I-2"	Unknown
S-416	E	Substation "O"	Unknown
S-505	E	Fuel Oil Storage	Unknown
S-506	E	Fuel Oil Storage	Unknown
S-509	E	Fuel Oil Reclamation Plant	Unknown
S-701	E	Open Storage Area (Bar Rack)	Unknown
S-702	E	Open Storage Area (Bar Rack)	Unknown
S-703	E	Open Storage Area (Bar Rack)	Unknown
S-704	E	Open Storage Area (Plate Rack)	Unknown
S-705	E	Open Storage Area (Plate Rack)	Unknown
S-706	E	Open Storage Area (Plate Rack)	Unknown
S-707	E	Open Storage Area (Plate Rack)	Unknown
S-708	E	Open Storage Area (Plate Rack)	Unknown
S-709	E	Open Storage Area (Plate Rack)	Unknown
S-710	E	Open Storage Area (Plate Rack)	Unknown
S-711	E	Gasoline Tank (Storage for Building 709)	Unknown
S-712	E	Gasoline Tank (Storage for Building 709)	Unknown
S-713	E	Gasoline Tank (Storage for Building 709)	Unknown
S-714	E	Gasoline Tank (Storage for Building 709)	Unknown
S-715	E	Sand Handling Bin	Unknown
S-716	E	Substation "I-5"	Unknown
S-717	E	Small Arms Range (Outdoor)	Unknown
S-718	E	Playing Field and Facilities	Unknown
S-719	E	Incinerator; possible use by NRDL	Demolished
S-720	E	Explosive Storage Magazine	Unknown
S-721	E	TAC Calibration Range	Unknown

TABLE 3-3
CURRENT AND FORMER FACILITIES AT HPS
BY BUILDING NUMBER

Building/ Site No.	Parcel	Former Uses	Current Status
S-801	E	Diesel Oil Storage (Tank)	Unknown
S-802	E	Diesel Oil Storage (Tank)	Unknown
S-816	E	Substation “I-3”	Unknown
Salvage Yard	E	Pre-Disposal Disassembly Area for metals, equipment, and other reusable items that could have contained Ra-226 devices and other contaminants	Unoccupied
Shack on 79 Site	E	NRDL Support; “radioactive material”	Demolished
Shack on 80 Site	E	Laboratory Operations	Demolished
IR Site 78	F	Parcel F Subtidal Area	Unknown
S-102	F	Berthing Wharf	Not used
S-103	F	Quay Walls	Not used
S-104	F	Repair Pier	Not used
S-105	F	Repair Pier	Not used
S-110	F	Breakwater and Berthing Pier	Not used
S-111	F	Timber Platform	Unknown
S-141	F	Mooring Platform	Unknown
S-142	F	Mooring Platform	Unknown
S-143	F	Mooring Platform	Unknown
S-144	F	Mooring Platforms Berth 51	Not used
S-201	F	Ship Repair Graving Drydock	Not used
S-202	F	Berthing Wharf	Unknown
S-203	F	Berthing Quay Wall	Unknown
S-204	F	Berthing Quay Wall	Unknown
S-206	F	Repair Pier	Not used
S-502	F	Berthing Pier	Not used
S-503	F	Berthing Pier	Not used
S-504	F	Berthing Pier	Not used
Ships Berths (Total of 50)	F	Berthing of OPERATION CROSSROADS Ships; Berthing of the YGN-73 (disposal barge); NRDL Usage	Unused
Underwater Areas	F	Open water	Open water

TABLE 3-3
CURRENT AND FORMER FACILITIES AT HPS
BY BUILDING NUMBER

Building/ Site No.	Parcel	Former Uses	Current Status
160	Off Site	Sewage Pumping Station	Demolished
802	Off Site	Gasoline Station	Unknown
804	Off Site	Fresh Water Pumphouse	Unknown
806	Off Site	Inspectroscope Shelter	Unknown
815	Off Site	NRDL	Transferred to Mr. Ted Lowpensky for document storage (FUDS)
820	Off Site	Radiological Laboratory Cyclotron	Transferred to Mr. Ted Lowpensky for wood moulding shop (FUDS)
830	Off Site	Research Animal Facility Building “A”	Transferred to University of California at San Francisco (FUDS)
831	Off Site	Research Animal Facility Building “B”	Transferred to University of California at San Francisco (FUDS)
17-Nov	Off Site	24 Apartment Houses (Solomon’s Village)	Not occupied
53-56	Off Site	31 Apartments	Demolished
60-68	Off Site	31Apartments	Demolished
71-72	Off Site	31 Apartments	Demolished
D-19	Off Site	NRDL	Demolished
D-20	Off Site	NRDL	Demolished
D-21	Off Site	Supply Storehouse and NRDL	Demolished
D-22	Off Site	Supply Storehouse	Demolished
D-23	Off Site	Public Works Storehouse	Demolished
ICW-417	Off Site	Islais Creek General Warehouse	Unknown
ICW-418	Off Site	Islais Creek General Warehouse and NRDL	TMCM, Inc. formerly Hydro Chemical Services
ICW-427	Off Site	Islais Creek General Warehouse	Unknown
ICW-428	Off Site	Islais Creek General Warehouse	Unknown
IR-45	Utility Sites	Steam Lines	Under CERCLA investigation
IR-46	Utility Sites	Fuel Distributions Lines (Tank Farm)	Under CERCLA investigation
IR-47	Utility Sites	Fuel Distribution Lines (Tank S-505)	Under CERCLA investigation
IR-48	Utility Sites	Suspected Steam lines (Buildings 203 and 208)	Under CERCLA investigation
IR-49	Utility Sites	Fuel Distribution Lines (Buildings 203 and 208)	Under CERCLA investigation
IR-50	Utility Sites	Storm Drains and Sanitary Sewers	Under CERCLA investigation
IR-51	Utility Sites	Former Transformer Locations	Under CERCLA investigation
Septic Systems and Drain Fields	Utility Sites	Septic Systems	Abandoned in place

TABLE 3-4
SCHOOLS LOCATED WITHIN A 1-MILE RADIUS OF HPS

School	Address and Telephone No.	Age Range (Years)	Program Times	No. of Children in Program
Bret Harte Elementary School	11035 Gilman Avenue (415) 330-1520	5 to 10	8:40 – 2:20	350
Bret Harte Pre-K to 5th Grade	950 Hollister Avenue (415) 330-1545	3 to 9	7:00 – 6:00	215
Burnett Nursery & School-Age	1520 Oakdale Avenue (415) 695-5660	3 to 10	3-5 years full day 1-5th Half day	Pre-K: 48 K to 5th: 136
Caheed Infant Daycare	1030 Oakdale Avenue (415) 821-1300	0 to 3	Full day	35 (licensed for 45)
Dr. Charles R. Drew Elementary	59 Pomona Street (415) 330-1526	5 to 10	K; 8:35 – 1:45 1-5; 8:35 – 2:40	260 Pre-K; summer
Frandelja Enrichment Center	950 Gilman Avenue (415) 822-1699	6 weeks to 4 years, 9 months	6:30 – 6:00	70
George Washington Carver Elementary	1360 Oakdale Avenue (415) 330-1540	4 years, 9 months, to 10 years	8:20 – 2:40	320 - 340
Gloria R. Davis Middle School	1195 Hudson Avenue (415) 695-5390	11 to 14	10:00 – 7:00	182
Bayview Beacon (Gloria R. Davis Middle School)	1195 Hudson Avenue (415) 695-5416	6 to 18	7:30 – 4:30 9:00 – 3:00 (summer only)	90
Head Start	125 W. Point Road (415) 824-4686	3 to 5	Full Day	30
Ideal Daycare	1523 La Salle Avenue (415) 821-7269	Newborn to 10	7:00 – 5:30	14
Karen’s Family Day Care	1547 Innes Avenue (415) 282-7383	0 to 5	Full day	6
Lucy Harber Academy	1744 Palou Avenue (415) 826-2194	2.5 to 12	7:00 – 6:00	12
Malcolm X Academy	350 Harbor Road (415) 695-5950	5 to 12	7:45 – 6:00	300 – day 120 -after school
Martin Luther King Child Care	200 Cashmere Street (415) 821-7000	2.5 to 8	7 – 5:30	63
Kipp Bayview Academy	1060 Key Avenue (415) 467-2522	9 to 10	7:45 – 5:00	86

4.0 HRA METHODOLOGY

An HRA is a tool used by the Navy to provide a comprehensive review and assessment of the impact of radiological operations at Navy or U.S. Marine Corps installations. This section describes the processes used by the Navy to prepare an HRA.

4.1 HRA OVERVIEW

Documentation of operations involving radioactive materials conducted at a Navy or Marine Corps installation, regulatory controls of these operations, and closeout surveys following the operations are vital to the future uses of current and former Navy and Marine Corps property. The Navy uses an HRA to document historical radiological operations at an installation and to recommend future actions. This gives Navy management a critical tool needed to properly control, investigate, and/or release property.

This HRA generally follows the guidelines in MARSSIM for preparation of a Historical Site Assessment and provides information in a format similar to the PA protocol used by the EPA within the CERCLA process **(HRA-2937)**.

An HRA provides historical documentation of radiological operations for a specified period. Since HPS is closed and being prepared for transfer as the result of the BRAC Program, this HRA documents radiological operations from establishment of HPS up to the time of closure and subsequent radiological surveys and investigations through June 2003. Results of radiological investigations conducted after that date will be reported in separate documents.

4.2 PURPOSE

The purpose of Volume II of the HPS HRA is to document radiological operations involving G-RAM. This includes the following radiological operations and investigations:

- Hunters Point Naval Shipyard (also known as San Francisco Naval Shipyard and San Francisco Bay Naval Shipyard): 1939-1974
- Decontamination and experimentation on ships returned from OPERATION CROSSROADS: 1946-1951
- Radiological experimentation conducted by the San Francisco Naval Shipyard Radiation Safety Section (RSS) or Radiation Laboratory (RADLAB): 1946-1948
- NRDL: 1948-1969
- Triple A: 1976-1986
- Hunters Point Annex: 1985-1989
- Navy, regulatory, and contractor investigations: 1946-2003

In general, this volume provides the following information about these radiological operations:

- History of buildings, structures, and outdoor areas impacted by radiological operations
- Potential, likely, or known sources of radioactive material and radioactive contamination
- Previous investigation results
- Contamination migration assessments
- Recommended future actions

4.3 MARSSIM GUIDELINES

This section describes MARSSIM guidance and how it applies to the HPS HRA.

4.3.1 Historical Site Assessment

Preparation of this HRA is the first step in following MARSSIM guidelines for evaluating the effects of past radiological operations. This is followed by scoping surveys and, if necessary, site characterization and remedial actions. The final action to demonstrate regulatory compliance for free release of the property is the FSS. The FSS report is the final clearance document for a property that is presented to regulators and the public.

Per MARSSIM guidance, this HRA will:

- Identify potential, likely, or known sources of radioactive material and radioactive contamination based on existing or derived information
- Identify sites that need further action as opposed to those posing no risk to human health or the environment from radiological operations
- Provide an assessment for the likelihood of contamination migration
- Provide information useful to scoping and characterization surveys
- Provide initial classification of the area or survey unit as impacted or non-impacted

4.3.2 Historical Research

MARSSIM recommends that historical information be collected by:

- Reviewing site evaluations; Federal, state, and local investigations; and emergency actions
- Reviewing existing radiological data in licenses, site permits, authorizations, and operating records
- Interviewing previous employees or personnel with knowledge of radiological operations at the site
- Performing site reconnaissance by reviewing maps and blueprints and conducting a physical inspection of facilities
- Using professional judgment

4.3.3 Non-Impacted and Impacted Sites

After review of the information obtained during historical research, MARSSIM recommends assigning a general preliminary area classification of "non-impacted" or "impacted" to all areas at the site.

Non-impacted areas are those with no history of radiological operations or those that have no reasonable potential for residual contamination such as residential or administrative buildings. Areas with only standard safety devices that contain generally licensed radioactive material, such as smoke detectors or exit signs, are classified as non-impacted if the site has no other radiological history. Non-impacted areas are not considered for radiological investigation because there is no reasonable potential for radioactive material to be present. Should information become available that identifies radiological operations associated with a non-impacted area, the area is reclassified as impacted. Discovery of minimal radioactivity attributable to natural background radiation or fallout from weapons testing is not, in itself, cause for designation of an area as impacted. Areas containing machines that produced ionizing radiation (such as x-ray machines) are not classified as impacted based solely on the use of the machines.

Impacted areas are generally those with a history of radiological operations and therefore having the potential for residual radioactive contamination. Examples include locations where leaks or spills are known to have occurred, former burial or disposal sites, areas where radioactive decontamination was performed, or radium paint facilities. Although an impacted site may be remediated and released as free from residual contamination, the site is not generally reclassified as non-impacted.

4.3.4 Potentially Contaminated Media

Once an area is properly classified, the next process involves the identification of potentially contaminated media within the area. While MARSSIM focuses on surface soils and building surfaces, it also provides preliminary guidance on other media types, including:

Surface Media – A term used to describe the top layer of soil, fill, gravel, waste piles, concrete, or asphalt that is available for direct exposure, growing plants, resuspension of particles for inhalation, and mixing from human disturbances.

Subsurface Media – A term used to describe solid materials below the surface medium.

Surface Water – A term used to describe waters from streams, rivers, lakes, coastal tidal waters, and oceans.

Groundwater – A term used to describe the waters contained in subsurface materials and aquifers.

Air – A term used to describe a pathway for resuspension and dispersal of contaminated media in the atmosphere.

Structures – A term used to describe man-made surfaces that are above or below the ground surface, such as buildings and drydocks.

4.3.5 Survey Classifications

MARSSIM classifies survey requirements for impacted areas as Class 1, 2, or 3, depending upon the potential for residual contamination. The classification of a building, structure, or site is a critical step in the survey design process and is used to ensure that areas with higher potential for contamination receive a higher degree of survey effort, with Class 1 areas having the greatest potential for contamination.

The criteria used for designating an area as Class 1, 2, or 3 are usually described in the survey or site work plan. As surveys progress and data are analyzed, areas may be reclassified based on newly acquired survey data. For example, if contamination is found in a Class 3 area, it typically is reclassified as Class 1 or Class 2, depending on the results of the survey. These same categories will be applied to any recommended actions listed in Section 8.0. The three classification categories are described in more detail below.

4.3.5.1 Class 1 Areas

An impacted area that is recognized as having a high potential for radioactive contamination, is known to have contamination, or had a prior remediation to remove radioactive contamination is usually designated as a Class 1 area. This would include any area known to contain contamination in excess of release limits based on a scoping or characterization survey. For HPS, examples of Class 1 areas include locations where leaks or spills are known to have occurred; former burial or disposal sites; radioisotope storage locations; waste processing, packaging, and storage sites; laboratories where unsealed sources were used; radium dial paint shops; and areas previously designated as Class 2 or 3 where contamination above the release limits has been found.

Class 1 areas require 100 percent systematic surveys. To conduct these surveys, each area is divided into survey units to facilitate the survey process and analysis of the survey data. The maximum area of a Class 1 survey unit is 100 square meters for floor area of buildings and 2,000 square meters for open land areas. Sizes of the survey units depend on the type and dimensions of the building, structure, or area.

4.3.5.2 Class 2 Areas

An impacted area that is recognized as having a potential for radioactive contamination but is not expected to exceed the release limit is usually designated as a Class 2 area. This would include any area known to contain minor isolated areas of contamination with low potential for exposure or buffer zones around Class 1 areas. For HPS, examples of Class 2 areas include radioluminescent device and check source storage areas, laboratories where sealed sources were used, and Class 3 areas where minimal contamination was found.

Class 2 areas require systematic surveys over 10 to 100 percent of the area. The area is divided into survey units to facilitate the survey process and analysis of the survey data. The maximum area of a Class 2 survey unit is 1,000 square meters for floor areas of buildings and 10,000 square meters for open land areas. Sizes of the survey units depend on the type and dimensions of the building, structure, or area.

4.3.5.3 Class 3 Areas

An impacted area that is not expected to contain residual contamination exceeding the release limit is usually designated as a Class 3 area. This could include buffer zones around Class 1 or 2 areas. For HPS, examples of Class 3 areas include laboratory administrative areas, general laboratory supply areas, previously decontaminated and surveyed areas, scrap or salvage yards, foundries, and smelters or incinerators.

Surveys of Class 3 areas are not standardized and may be conducted randomly. There is no limit to the size of a survey unit. Sizes of the survey units depend on the type and dimensions of the building, structure, or area.

4.4 PREPARATION OF THE HPS HRA

The approach and rationale of the HRA, document reviews, field investigations, and interviews, site designation, radionuclide identification, and evaluation of previous investigations conducted specifically to prepare the HPS HRA are discussed below.

4.4.1 HPS HRA Approach and Rationale

Preparation of the HPS HRA presented an unusual set of challenges because radiological operations ceased at the site in the 1980s. In addition, multiple radiological investigations have been conducted since closure of the shipyard. Where an HRA usually lays the groundwork for initiation of radiological investigations, the HPS HRA reviews historical radiological operations and past radiological investigations to provide a complete picture of the current radiological status of the site.

To prepare the HPS HRA, all available historical and current radiological and non-radiological information was evaluated. This research became the basis for designating sites as non-impacted or impacted and will subsequently be used by the Navy and other Federal, state, and local regulators to determine future actions for the sites.

Obtaining and evaluating information during preparation of the HRA included:

- Archival research
- Site assessments and reconnaissance
- Personal interviews
- Site designation and classification
- Identification of radionuclides of concern

These activities are discussed in Sections 4.4.2 through 4.4.6.

4.4.2 Archival Research

Because Navy operations at HPS were discontinued in 1989, archival research was the primary method used to prepare the HPS HRA. Every effort was made to find as many records as possible concerning radiological operations at HPS. Many documents had been destroyed because Federal and Navy record retention requirements allow record destruction after a designated amount of time. Both government and private archives were reviewed.

A listing of all archival documents and sources used as references in this HRA are detailed in chapter-specific listings in Section 10.0. Electronic copies of documents used as references are provided on compact discs as Appendix D. The numbering of the references is not consecutive because they correspond directly to the database of historical information compiled during research for the HRA.

4.4.2.1 Archive Locations

Table 4-1 lists archives where information on HPS was found. Thousands of pertinent documents varying in length from 1 to 900 pages and more than 750 maps and drawings were reviewed.

4.4.2.2 Archive Information

Archival information was reviewed to identify potential G-RAM sources, areas of use, radiological controls, regulatory procedures, and releases of radioactive materials at HPS. Reviews of historical records identified the following main categories of radiological operations.

Naval Shipyard Operations, 1939-1974 and 1985-1989: Radiological operations included typical ship overhaul and repair functions involving the removal, repair, and installation of radioluminescent devices. AEC licenses were issued for gamma radiography operations and an instrument calibration laboratory after 1954. Typical shipyard documents included instructions and directives, reports, maps, and newspaper articles as well as correspondence from Navy Bureau of Ships (BUSHIPS); Navy Bureau of Medicine and Surgery (BUMED); and the Commander, Western Sea Frontier. A radiological history of shipyard operations is provided in Section 6.1.

Decontamination of and Experimentation on Ships from OPERATION CROSSROADS, 1946-1951: Radiological operations included the establishment of decontamination procedures; disposal of contaminated equipment, fuel, and water; and experimentation on the effects of fission products on various materials. Typical documentation includes early directives on radiation safety, procedures for the conduct of radiological operations, status reports, and final clearance reports. A radiological history of OPERATION CROSSROADS and its impact on HPS is provided in Section 6.2.

RADLAB, 1946-1948: Immediately following WW II, the Navy recognized the need to study the effects of radiation and to develop procedures for working with radioactive materials. To accomplish this goal, the Navy established the RSS at HPS. The RSS evolved into the RADLAB, which was the precursor of the NRDL. Records of RADLAB activities include procedures, surveys, records of animal experiments, and general correspondence related to radiological issues. The RADLAB history is included with the history of NRDL in Section 6.3.

NRDL, 1948-1969: Extensive and unique radiological operations were conducted throughout NRDL's history. Its primary mission was to study the effects of atomic weapons on Navy ships and personnel. Radioactive materials were used throughout NRDL's history. After 1954, most of those materials were authorized by AEC licenses. Typical NRDL documents included detailed technical reports, radiological safety reports, planning documents, correspondence, radioactive material procurement requests, procedures for handling and disposal of radioactive waste, and applications for AEC licenses. A radiological history of NRDL is provided in Section 6.3.

Triple A, 1976-1986: Triple A leased large portions of HPS from the Navy to perform work on Naval and commercial vessels. Very few documents on Triple A operations were found. However, it is known they performed typical ship overhaul and repair functions that could have involved the removal, repair, and installation of radioluminescent devices. Triple A was not issued a license by the NRC or the State of California for use of licensed quantities of radioactive material. Limited information on Triple A is provided in Section 6.1.

4.4.3 Site Assessments and Reconnaissance

4.4.3.1 Historical Assessments

Throughout its history, HPS has been assessed for residual contamination from radiological operations. These assessments included SIs to assess physical hazards and the structural integrity of buildings. This was followed by radiological remediations or release surveys that included scans, direct measurements, air and soil sample analysis, and swipe sample analysis. These methods were used to evaluate the radionuclides of concern and associated release limits at the time of the survey.

Historically, assessments were performed by the Navy; Navy contractors; and Federal, state, and local regulatory agencies. Section 6.4 includes a synopsis of each known radiological assessment, including investigation techniques and findings, from 1946 through 2003. Section 5.0 discusses the types of radioactive materials used at HPS. A generic description of pathways these materials could have taken to impact human health and the environment is detailed in Section 7.0. A comprehensive site-specific summary of this information is provided for each impacted site in Section 8.0.

4.4.3.2 Current Assessments

A series of radiological assessments was conducted at HPS from January 2002 to June 2003. Collectively identified as the Phase V Radiological Investigations, the scope of these assessments is addressed in Section 6.0. While the investigative results to date are summarized in Section 6.0, detailed results of these assessments will be documented in individual reports outside the context of this HRA.

4.4.3.3 HRA Site Reconnaissance

As a supplement to archival research, on-site visual inspections of areas with a history of radiological operations were conducted. Through these site visits, current facilities were compared with previous radiological assessments, historical documentation, and maps. Many of the remaining buildings still had various warning signs or operational restrictions posted. The on-site assessments did not include radiological surveys. The history for each impacted site, with descriptions of the current condition of the site, is provided in Section 8.0.

4.4.4 Interviews

During the multi-phase preparation of the HPS HRA, many personnel with knowledge of radiological operations at HPS were interviewed. These included ex-HPS, RADLAB or NRDL employees, visitors, and family members of former employees. The interviews were helpful to the research because they provided a first-hand account of radiological operations at HPS and supplemented available documentation.

Three separate interview processes have been conducted. The first occurred during an initial attempt to draft the HRA in 1997. The second was conducted during preparation of the Draft HRA that was released in 2002. Only 13 interviews resulted from attempts to locate knowledgeable individuals in 1997 and 2002.

The third and most extensive interview process was during preparation of the Draft Final HRA. It started in January and February 2003, when the Navy published an advertisement to locate individuals with knowledge of radiological operations at HPS as a means of supplementing interviews for the Draft Final HRA. This advertisement appeared in newspapers in the San Francisco and Sacramento areas, including the *San Francisco Chronicle, San Francisco Examiner, San Francisco Independent*, the *Bay View*, and the *Sacramento Bee.* The content of the advertisement is provided in Appendix B.

Over 200 personnel responded to the advertisement; however, approximately 40 of these had no knowledge of radiological operations at HPS. When respondents to the advertisement were contacted, they were informed about the purpose of the interview and given a brief background on the HRA. Topics discussed during the interview included the former employee's position; responsibilities; period(s) of employment; and how they were involved with, or knew of, radiological operations at HPS or NRDL. Personnel were assured that no personal information would be provided to another government or a private party without written permission of the interviewee.

Appendix B provides details of the interview process that was conducted during preparation of the Draft Final HRA as well as summaries of in-depth interviews that were conducted in 1997, 2002, 2003, and 2004.

4.4.5 Site Designation

Each building, structure, and open space at HPS has been designated as either radiologically non-impacted or impacted based on information derived from the archive reviews, site reconnaissance, and personal interviews. Impacted areas have been assessed as to the possibility and extent of residual contamination and recommendations of actions to evaluate the extent of potential residual radioactive contamination or radiologically free release of the property are provided. If a site has been previously radiologically free-released by the Navy and California regulators to current standards, no further action is recommended. Recommendations for each impacted site are provided in Section 8.0.

4.4.6 Radionuclide Identification

To properly assess a site, the HRA must determine any radionuclide that was used, who used it, and where it was used at HPS. Table 4-2 lists radionuclides that were used at HPS. This list was compiled by researching radiological operations and AEC licenses authorizing specific quantities and uses of radioactive material.

Any radionuclide that could have decayed through 10 half-lives since its time of use at HPS is no longer considered a radionuclide of concern. Table 4-3 lists the radionuclides that potentially are still a concern at HPS today.

4.5 HRA BOUNDARIES

4.5.1 Physical Boundaries

Because it is not the intent or purpose of this HRA to assess the radiological status of sites outside of HPS, it primarily addresses radiological operations within the physical boundaries of the shipyard as described in Section 3.0. However, this HRA also addresses radiological operations or support facilities directly related to HPS operations that were located in areas outside of the shipyard fence line but under the jurisdiction of, and in the vicinity of, the shipyard. These areas include Islais Creek Warehouses (ICW) 417, 418, 427, and 428 used by HPS and NRDL for storage, laboratory, and quality assurance operations. The only radiologically impacted building is ICW 418.

This HRA addresses radioactive waste collected, packaged, and loaded on vessels at HPS for disposal at the Farallon Islands and other disposal sites, but it does not address the disposal sites because they have no direct bearing on the radiological conditions at HPS. Also discussed is work done on the OPERATION CROSSROADS ships that were returned to HPS. Information on their final destination is provided, but the HRA does not address the test site, sites where the target vessels were sunk, or other methods of their disposal.

This HRA does not include remote site radiological operations conducted by NRDL at the following locations:

- Naval Base, San Bruno, California; used for decontamination experiments using short-lived radionuclides and materials storage
- Camp Parks near Dublin, California; used for radioisotope testing on animals
- Camp Stoneman in Pittsburg, California; used to conduct decontamination studies
- Nuclear weapons test sites

A map of HPS areas covered by the HRA is provided in Figure 4-1.

4.5.2 Temporal Boundaries

The Navy obtained the HPS property in 1939 and started operating the shipyard as a Navy facility in 1941. For purposes of this HRA, the temporal HRA boundaries are October 1939 through June 2003. The site-specific Phase V Radiological Investigations at HPS that began in January 2002 and continued through June 2003 are summarized in this HRA. However, final reports of Phase V Radiological Investigations will be provided in separate site-specific reports.

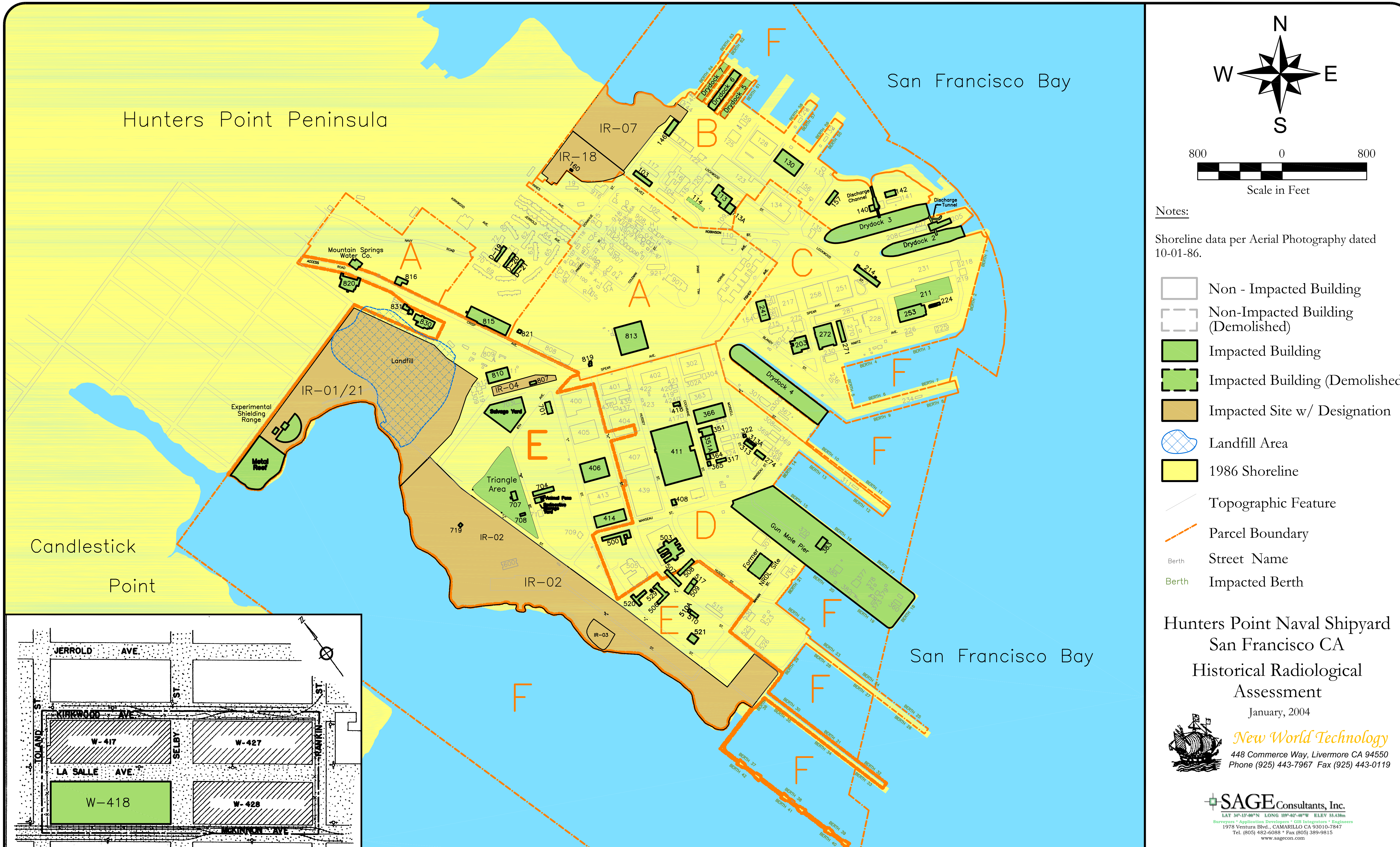


Figure 4-1
Overall Impacted Sites

SECTION 4
TABLES

TABLE 4-1
ARCHIVE LOCATIONS

Archive Facility	Location
National Archives and Records Administration (NARA)	San Bruno, California
Federal Records Center	San Bruno, California
Department of Energy/Bechtel Public Reading Facility	Las Vegas, Nevada
Naval Historical Center	Washington, DC
Naval Sea Systems Command Detachment, Radiological Affairs Support Office	Yorktown, Virginia
NARA	College Park, Maryland
Los Alamos National Laboratory	Albuquerque, New Mexico
Nuclear Regulatory Commission, Region II	Atlanta, Georgia
Naval Research Laboratory	Washington, DC
Tetra Tech EM Inc.	San Francisco, California
National Oceanographic and Atmospheric Administration	
National Climatic Data Center	
Personal records of the late Dr. C. Sharp Cook	
Personal records from interviewees	

TABLE 4-2 RADIONUCLIDES USED AT HPS		
Radionuclide	**Half-Life**	**Radiation**
Ac-227 (Actinium)	21.8 Years	Alpha, beta^{-}, and gamma
Ag-110 (Silver)	24.6 Seconds	Beta^{-} and gamma
Am-241 (Americium)	432.7 Years	Alpha and gamma
Am-243	7,370 Years	Alpha gamma
As-73 (Arsenic)	80.3 Days	Beta^{-} and gamma
As-76	26.3 Hours	Beta^{-} and gamma
Au-195 (Gold)	186 Days	Gamma
Au-198	2.7 Days	Beta^{-} and gamma
Ba-133 (Barium)	10.5 Years	Beta^{-} and gamma
Ba-140	12.8 Days	Beta^{-} and gamma
Be-7 (Beryllium)	52.28 Days	Beta^{-} and gamma
Bi-207 (Bismuth)	32 Years	Beta^{-} and gamma
Bi-210	5.01 Days	Beta^{-} and gamma
Br-82 (Bromine)	1.47 Days	Beta^{-} and gamma
C-14 (Carbon)	5715 Years	Beta^{-}
Ca-45 (Calcium)	162.7 Days	Beta^{-} and gamma
Cd-109 (Cadmium)	462 Days	Gamma
Cd-115	2.23 Days	Beta^{-} and gamma
Ce-141 (Cerium)	32.5 Days	Beta^{-} and gamma
Ce-144	284.6 Days	Beta^{-} and gamma
Cf-252 (Californium)	2.65 Years	Alpha, beta^{-}, and gamma
Cl-36 (Chlorine)	3.01×10^{5} Years	Beta^{-}
Cm-242 (Curium)	162.8 Days	Alpha and gamma
Cm-244	18.1 Years	Alpha and gamma
Co-57 (Cobalt)	271 Days	Gamma
Co-58	70.9 Days	Beta^{-} and gamma
Co-60*****	5.27 Years	Beta^{-} and gamma
Cr-51 (Chromium)	27.7 Days	Gamma
Cs-134 (Cesium)	2.07 Years	Beta^{-} and gamma
Cs-137*****	30.1 Years	Beta^{-} and gamma
Eu-152 (Europium)	13.5 Years	Beta^{-} and gamma
Eu-154	8.6 Years	Beta^{-} and gamma
Eu-155	4.8 Years	Beta^{-} and gamma
Eu-156	15.2 Days	Beta^{-} and gamma
Fe-55 (Iron)	2.73 Years	Gamma
Fe-59	45.5 Days	Beta^{-} and gamma
Gd-152 (Gadolinium)	1.1×10^{14} Years	Alpha
Ge-68 (Germanium)	270.8 Days	Beta^{-} and gamma
H-3 (Tritium)	12.3 Years	Beta^{-}
Hg-203 (Mercury)	46.6 Days	Beta^{-} and gamma

TABLE 4-2
RADIONUCLIDES USED AT HPS

Radionuclide	Half-Life	Radiation
I-125 (Iodine)	59.4 Days	$Beta^-$ and gamma
I-129	1.57×10^7 Years	$Beta^-$ and gamma
I-131	8 Days	$Beta^-$ and gamma
In-115 (Indium)	4.4×10^{14} Years	$Beta^-$
Ir-192***** (Iridium)	73.8 Days	$Beta^-$ and gamma
K-40 (Potassium)	1.27×10^9 Years	$Beta^-$ and gamma
K-42	12.36 Hours	$Beta^-$ and gamma
Kr-85 (Krypton)	10.76 Years	$Beta^-$ and gamma
La-140 (Lanthanum)	1.68 Days	$Beta^-$ and gamma
Lu-177 (Lutetium)	6.71 Days	$Beta^-$ and gamma
Mn-54 (Manganese)	312.1 Days	$Beta^-$ and gamma
Mo-99 (Molybdenum)	2.75 Days	$Beta^-$ and gamma
Na-22 (Sodium)	2.6 Years	$Beta^+$ and gamma
Na-24	14.95 Hours	$Beta^-$ and gamma
Nb-94 (Niobium)	2×10^4 Years	$Beta^-$ and gamma
Nd-147 (Neodymium)	10.98 Days	$Beta^-$ and gamma
Ni-63 (Nickel)	100 Years	$Beta^-$
Np-237 (Neptunium)	2.14×10^6 Years	Alpha and gamma
P-32 (Phosphorus)	14.28 Days	$Beta^-$
Pa-234 (Protactinium)	6.7 Hours	$Beta^-$ and gamma
Pb-210 (Lead)	22.6 Years	$Beta^-$ and gamma
Pd-109 (Palladium)	13.5 Hour	$Beta^-$ and gamma
Pm-147 (Promethium)	2.62 Years	$Beta^-$ and gamma
Po-210 (Polonium)	138.4 Days	Alpha and gamma
Pr-143 (Praseodymium)	13.57 Days	$Beta^-$ and gamma
Pr-144	17.28 Minutes	$Beta^-$ and gamma
Pu-237 (Plutonium)	45.2 Days	Alpha and gamma
Pu-238	87.7 Years	Alpha and gamma
Pu-239*****	$2.41 X 10^4$ Years	Alpha and gamma
Ra-226***** (Radium)	1,599 Years	Alpha and gamma
Rn-222 (Radon)	3.82 Days	Alpha and gamma
Rb-86 (Rubidium)	18.65 Days	$Beta^-$ and gamma
Ru-103 (Ruthenium)	39.27 Days	$Beta^-$ and gamma
Ru-106	1.02 Years	$Beta^-$
S-35 (Sulfur)	87.2 Days	$Beta^-$
Sb-125 (Antimony)	2.76 Years	$Beta^-$ and gamma
Sc-46 (Scandium)	83.8 Days	$Beta^-$ and gamma
Se-75 (Selenium)	119.8 Days	Gamma
Sm-145 (Samarium)	340 Days	Gamma
Sm-153	1.93 Days	$Beta^-$ and gamma

TABLE 4-2
RADIONUCLIDES USED AT HPS

Radionuclide	Half-Life	Radiation
Sn-113 (Tin)	115.1 Days	$Beta^-$ and gamma
Sr-85 (Strontium)	64.84 Days	Gamma
Sr-89	50.52 Days	$Beta^-$ and gamma
Sr-90*****	28.78 Years	$Beta^-$
Ta-182 (Tantalum)	114.4 Days	$Beta^-$ and gamma
Tb-161 (Terbium)	6.91 Days	$Beta^-$ and gamma
Tc-97 (Technetium)	2.6×10^6 Years	$Beta^-$ and gamma
Tc-99	2.1×10^5 Years	$Beta^-$ and gamma
Te-127 (Tellurium)	9.4 Hours	$Beta^-$ and gamma
Te-133	12.4 Minutes	$Beta^-$ and gamma
Te-133m	55.4 Minutes	$Beta^-$ and gamma
Th-228***** (Thorium)	1.91 Years	Alpha and gamma
Th-232	1.4×10^{10} Years	Alpha
Ti-44 (Titanium)	67 Years	Gamma
Tl-204 (Thallium)	3.78 Years	$Beta^-$
Tm-170 (Thulium)	128.6 Days	$Beta^-$ and gamma
Tm-171	1.92 Years	$Beta^-$ and gamma
U-233 (Uranium)	1.59×10^5 Years	Alpha and gamma
U-235	7.04×10^8 Years	Alpha and gamma
U-236	2.34×10^7 Years	Alpha and gamma
U-238	4.478×10^9 Years	Alpha and gamma
W-185 (Tungsten)	74.8 Days	$Beta^-$ and gamma
Xe-133 (Xenon)	5.24 Days	$Beta^-$ and gamma
Y-88 (Yttrium)	106.7 Days	$Beta^+$ and gamma
Y-90	2.67 Days	$Beta^-$ and gamma
Y-91	58.5 Days	$Beta^-$ and gamma
Zn-65 (Zinc)	243.8 Days	$Beta^+$ and gamma
Zr-95 (Zirconium)	64 Days	$Beta^-$ and gamma

Note:

***** Indicates use by the shipyard for radiography, instrument calibrations or radioluminescent devices.

Source: *Chart of the Nuclides, Knolls Atomic Power Laboratory*, Fifth Edition.

TABLE 4-3
RADIONUCLIDES OF CONCERN AT HPS

Radionuclide	Half Life	Radiations
Ac-227 (Actinium)	21.8 Years	Alpha, beta, and gamma
Am-241 (Americium)	432.7 Years	Alpha, beta, and gamma
Am-243	7,370 Years	Alpha and gamma
Ba-133 (Barium)	10.5 Years	Beta and gamma
Bi-207 (Bismuth)	32 Years	Beta and gamma
C-14 (Carbon)	5715 Years	Beta
Cl-36 (Chlorine)	3.01×10^5 Years	Beta
Cm-244 (Curium)	18.1 Years	Alpha and gamma
Co-60 (Cobalt)	5.27 Years	Beta and gamma
Cs-137 (Cesium)	30.1 Years	Beta and gamma
Eu-152 (Europium)	13.5 Years	Beta and gamma
Eu-154	8.6 Years	Beta and gamma
Gd-152 (Gadolinium)	1.1×10^{14} Years	Alpha
H-3 (Tritium)	12.3 Years	Beta
In-115 (Indium)	4.4×10^{14} Years	Beta
K-40 (Potassium)	1.27×10^9 Years	Beta and gamma
Nb-94 (Niobium)	2×10^4 Years	Beta and gamma
Ni-63 (Nickel)	100 Years	Beta
Np-237 (Neptunium)	2.14×10^6 Years	Alpha and gamma
Pb-210 (Lead)	22.6 Years	Beta and gamma
Pu-238 (Plutonium)	87.7 Years	Alpha and gamma
PU-239	2.41×10^4 Years	Alpha, beta, and gamma
Ra-226 (Radium)	1,599 Years	Alpha and gamma
Sr-90 (Strontium)	28.78 Years	Beta
Tc-97 (Technetium)	2.6×10^6 Years	Beta and gamma
Tc-99	2.1×10^5 Years	Beta and gamma
Th-232 (Thorium)	1.4×10^{10} Years	Alpha
Ti-44 (Titanium)	67 Years	Gamma
Tl-204 (Thallium)	3.78 Years	Beta
U-233 (Uranium)	1.59×10^5 Years	Alpha and gamma
U-235	7.04×10^8 Years	Alpha and gamma
U-236	2.34×10^7 Years	Alpha and gamma
U-238	4.478×10^9 Years	Alpha and gamma

5.0 REGULATORY INVOLVEMENT

This section provides an overview of regulatory agencies involved with the oversight of radioactive materials and their use at HPS. Included is the regulatory authority and requirements for the HRA as well as the involvement of regulatory agencies at HPS and NRDL.

5.1 FEDERAL REGULATORY AGENCIES

5.1.1 AEC

The Atomic Energy Act (AEA) of 1 August 1946 established the AEC to develop and manage the atomic energy program following WW II. A civilian government agency, the AEC assumed responsibility for control of radioactive material and its uses from the military's Manhattan Project, the group that developed the atomic bomb during WW II. The AEC's mission included the production and control of fissionable material, accident prevention, research, and peaceful uses of the atom, including the commercial generation of electricity. While the AEC had control of atomic energy production and nuclear materials, facilities using the materials remained under government control. The act provided for a five-member commission, the General Advisory Committee, as well as a Military Liaison Committee within the National Military Establishment, which worked with the AEC on military applications of atomic energy.

In 1953, the DoD established the Committee on Atomic Energy (CAE) to provide assistance and guidance for research and development activities within DoD. The main fields of interest for the CAE were atomic research and its effect on national security and research and development of atomic energy for military use. During this time, the AEC and DoD also formalized the "Agreement for the Development, Production and Standardization of Atomic Weapons" that established regulations to prevent conflicts of responsibility between the military and the AEC **(HRA-2923)**.

The AEC controlled uses of radioactive materials by issuing "authorizations" or "permits" until 1954, when the AEA was modified. This modification amended AEC controls and established the licensing program, which allowed for partnerships with private facilities to produce fissionable materials. An additional amendment in 1964 permitted private ownership of nuclear fuels, aiding the growing nuclear power industry.

The AEC was dissolved when the Energy Reorganization Act of 1974 established two new federal agencies to administer and regulate atomic energy activities: the U.S. Energy Research and Development Administration (ERDA) and the NRC. The NRC assumed responsibilities for regulation of the byproduct, source, and special nuclear material previously controlled by the AEC. Military applications of radioactive material remained under the control of ERDA, which was renamed the DOE in 1977.

5.1.2 AEC Licensing Controls

With the establishment of AEC licensing controls in 1954, procurement and use of radioactive materials became more stringently controlled. Users were required to submit lengthy “license applications,” with different license types required for byproduct, source, or special nuclear material. AEC required license applications to include:

- Quantity of each radionuclide to be possessed at any one time
- Purposes for which the licensed material was used
- Location where radioactive materials were used
- Qualifications of a Radiation Safety Officer
- Demonstration that facilities were adequate to safely control materials and protect human health
- Administrative and managerial controls
- Monitoring procedures and instrumentation
- Material receipt and accountability procedures
- An occupational radiation safety program for workers
- Standard operating and emergency procedures
- Radioactive waste disposal procedures

5.2 NAVY RADIOACTIVE MATERIALS CONTROLS

5.2.1 General Controls

The first formal document controlling use of radioactive material by the Navy was Safety Series No. 9 of 1942 for radium-226 (Ra-226) **(HRA-2930)**. However, the Navy did not establish a formal radiological controls program for all types of radioactive material until 1946, shortly after the end of WW II. These controls were the predecessors of the more stringent radiological controls programs the Navy has in effect today. The first Radiological Safety Manual for general applications of radioactive material was issued in 1947 by the Chief of Naval Operations (CNO) **(HRA-2715)**. This manual was based on knowledge gained from the bombing of Hiroshima and Nagasaki and OPERATION CROSSROADS testing of the atomic bomb. As experience with and knowledge of the effects of radiation on ships and naval personnel grew, the Navy worked to establish more protective requirements that met or exceeded Federal regulations.

In the late 1940s and early 1950s, BUMED and BUSHIPS worked closely with the RADLAB and NRDL at HPS to develop controls for use of radioactive material throughout the Navy. BUMED established and incorporated safety tolerances into regulations, determined physiological effects and developed treatment methods, and approved specifications for instruments to cover medical uses and exposure to radioactive materials. BUMED continues to oversee the radiation health protection program in the Navy and Marine Corps today.

BUSHIPS developed and procured instruments to detect radioactivity, equipment to protect personnel onboard ships, and methods and equipment for decontaminating ships. Eventually, the Navy reorganized, and these responsibilities were assigned to the NAVSEA. Today, NAVSEA remains responsible for the use of radioactive material by the Navy and Marine Corps and provides oversight and regulatory guidance to the NNPP, Nuclear Weapons Radiological Controls Program, and G-RAM Program (known as the Radiological Affairs Support Program [RASP]).

5.2.2 AEC Licensing of Navy Headquarters Commands

In some instances, the Navy's headquarters commands applied to the AEC for authority to use licensed radioactive material. The AEC licenses were issued to a single headquarters command even though the material might only be used by an individual field command or ship. In some instances, the licenses authorized use of a radioactive commodity by multiple commands. Five such licenses that directly involved HPS are listed below. Table 5-1 contains additional information about these licenses.

AEC Special Nuclear Material License No. SNM-379 was issued to BUSHIPS. Date of issuance, 1961, and termination, 1967. The license authorized use of plutonium-239 in sealed check sources. San Francisco Naval Shipyard (HPS) was the user site **(HRA-2837)**.

AEC Special Nuclear Material License No. SNM-397 was issued to BUSHIPS. Dates of issuance and termination are unknown. The license authorized use of plutonium-239 in sealed planchets. San Francisco Naval Shipyard (HPS) was the user site.

AEC Byproduct Material License No. 08-00038-06 was issued to BUSHIPS in 1959; however, the termination date is unknown. The license authorized the use of strontium-90 sources of varying strengths for calibration of survey instruments. HPS was on the list of user sites **(HRA-2893)**.

AEC Byproduct Material License No. 08-00038-13 was issued to BUSHIPS in 1961. Historical information indicates that a request for termination was submitted in 1968. The license authorized the use of promethium-147 (Pm-147) in experimental luminous markings on prototype submersible wristwatches and compasses. NRDL was listed as the user site **(HRA-2892)**.

AEC Byproduct Material License No. 08-03978-08 was issued to BUSHIPS. Dates of issuance and termination are unknown. The license authorized the use of Pm-147 in wrist compasses for Navy-wide use **(HRA-2892)**.

5.2.3 Establishment of Navy Radiation Safety Programs at HPS

In 1946, the CNO assigned BUSHIPS responsibility for development and procurement of detection instruments, shipboard personnel radiation monitoring devices, protective equipment, and methods and equipment for decontamination of ships **(HRA-1219)**. BUSHIPS established the RADLAB at HPS to perform this mission **(HRA-474)**.

The Scientific Director of the RADLAB petitioned to become a facility of the AEC in 1947 **(HRA-1284)**. This allowed requests from the laboratory for radioactive material to be handled as those from other AEC facilities. A general policy concerning this relationship was established in December 1947 **(HRA-1895)**. The policy permitted the RADLAB to deal directly with the AEC representatives in the Berkeley area on most matters instead of submitting requests through the Washington, DC, offices.

5.2.4 Establishment of NRDL

The RADLAB became the NRDL on 21 April 1948, under the direction of the Shipyard Commander **(HRA-587)**. Responsibilities and duties of the organization were detailed in Shipyard Order No. 29-49 of 12 April 1949 **(HRA-1097)**. NRDL was formally established as a command, separate from HPS, on 1 October 1950 **(HRA-457),** with a single Naval officer serving as Commanding Officer for both the shipyard and NRDL under the military command of the Commander, Naval Base, San Francisco, California. It was not until 16 September 1955, that the Navy recognized the separate missions of HPS and NRDL and named individual Commanding Officers for each command **(HRA-587)**.

NRDL's mission required strict accountability and control of radioactive materials for which they were responsible. To manage these issues, NRDL established a Radiological Safety Committee. In April 1949, this committee published "Rules and Procedures for Radiological Safety," the first individual document of its kind for a Navy command **(HRA-485)**. NRDL continued to use a committee to manage and control the use of radioactive material until its closure in 1969.

5.3 REGULATORY INVOLVEMENT AT HPS

The shipyard and NRDL were subject to the AEC licensing requirements for radioactive materials that began in 1954, with additional oversight provided by BUMED and BUSHIPS. The State of California became an Agreement State with the AEC on 1 September 1962, and established the California Agreement State Licensing Program managed by the CDHS. As Federal entities, NRDL and the shipyard remained under the AEC licensing program. However, it should be noted that use of radioactive material by Navy contractors or HPS lessees (such as Triple A) based in California would have fallen under auspices of the CDHS licensing program. The AEC licenses for NRDL and the shipyard are discussed below.

5.3.1 HPS AEC Licenses

HPS had multiple AEC licenses for possession and use of radioactive material. The history of licenses became difficult to track after the merger of HPS and MINS as the San Francisco Bay Naval Shipyard. As a result, the closure of HPS in 1974 did not necessarily result in termination of all AEC licenses with HPS as a location of use. These licenses are summarized below and detailed in Table 5-1.

AEC Byproduct Material License No. 04-01039-02 was issued in 1959 and converted to AEC License No. 04-00364-09 issued to San Francisco Bay Naval Shipyard in 1966. The license authorized use of radioactive materials for gamma radiography (**HRA-1469**).

AEC Byproduct Material License No. 04-01039-03 was issued in 1960 and incorporated into AEC License No. 04-00364-05 issued to San Francisco Bay Naval Shipyard in 1966. The license authorized use of radioactive materials for calibration of radiation detection instruments (**HRA-1470**).

AEC Byproduct Material License No. 04-00364-05 was issued to MINS in 1960. The license was amended in 1966 to include HPS as a user site. The license authorized use of radioactive materials for calibration of radiation detection instruments (**HRA-2891**).

AEC Byproduct Material License No. 04-00364-09 was issued to San Francisco Bay Naval Shipyard in 1966 and incorporated into AEC License No. 04-00364-06 issued to San Francisco Bay Naval Shipyard in 1966. The license authorized use of radioactive materials for gamma radiography (**HRA-2840**).

AEC Byproduct Material License No. 04-00364-06 was issued to MINS in 1959 and amended in 1966 to include HPS under the name of San Francisco Bay Naval Shipyard. An amendment issued in 1974 no longer included HPS as an authorized user site. The license authorized use of radioactive materials for gamma radiography (**HRA-2926**).

AEC Byproduct Material License No. 04-13597-01 was issued to HPS to replace AEC License No. 04-00364-06 and terminated in 1974. The license authorized use of radioactive materials for gamma radiography (**HRA-2796**).

AEC Byproduct Material License No. 04-13597-02 was issued to HPS as a replacement for AEC License No. 04-00364-05 and terminated in 1975 after the material was transferred to Naval Ordnance Laboratory in Silver Spring, Maryland. The license authorized use of radioactive materials for calibration of radiation detection instruments (**HRA-1264**).

5.3.2 Triple A Licenses

There are no records of NRC or CDHS issuing a radioactive material license to Triple A. Because Triple A did not have a license for radiological operations, it is assumed that licensed contractors were hired to perform the gamma radiography when it was needed. If radiation detection instrumentation was needed it could also have been obtained from a licensed contractor. Documentation of specific radiological operations concerning contractors hired by Triple A could not be located.

5.3.3 NRDL AEC Licenses

NRDL was authorized to use a broad spectrum of all types of radioactive materials for its research. These authorizations were incorporated into AEC licenses after 1954. In addition to the Radiation Safety Committee that managed accountability of radioactive material, the NRDL Radioisotope Committee was created to review and approve the use of radionuclides for research, and NRDL's Health Physics Division monitored the methods and locations of radionuclide use. At the time of NRDL's disestablishment in 1969, a specific license was issued for decommissioning activities. Prior to termination of NRDL's AEC licenses, all licensed sources were transferred to other licensed activities or sent to a radioactive waste disposal site. Surveys were conducted in areas where radioactive materials had been used. Inspectors from the AEC Division of Compliance conducted independent final clearance surveys to verify that areas released for unrestricted use met the standards of the time. NRDL's AEC licenses are summarized below and detailed in Table 5-1.

AEC Byproduct Material License No. 04-00487-03 was issued to NRDL as a Broad Scope License in 1958 and terminated in 1970. The license authorized general quantities of radionuclides and required specific uses to be approved by the NRDL Radiological Safety Committee and monitored by the Health Physics Division **(HRA-2788, HRA-3128)**.

AEC Byproduct Material License No. 04-00487-04 was issued and expired in 1958. The license authorized human studies using radioactive material **(HRA-2849)**.

AEC Byproduct Material License No. 04-00487-05 was issued and expired in 1958. The license authorized use of radioactive material in tracer studies at Camp Stoneman in Pittsburg, California **(HRA-1302)**.

AEC Byproduct Material License No. 04-00487-06 was issued in 1959 and expired in 1964. The license authorized the packaging and disposal of radioactive waste at sea (**HRA-2859**).

AEC Byproduct Material License No. 04-00487-07 was issued and expired in 1961. The license authorized human use studies using radioactive material (**HRA-2850**).

AEC Byproduct Material License No. 04-00487-08 was issued in 1963 and terminated in 1970. The license authorized use of radioactive material to perform high-intensity radiation studies at Camp Parks in Dublin, California (**HRA-2781**).

AEC Byproduct Material License No. 04-00487-09 was issued in 1968 and terminated after the material was transferred to another licensee in 1969. The license authorized use of radioactive material as fuel for the Special Nuclear Auxiliary Power Project being managed by NRDL (**HRA-2779, HRA-2853**).

AEC Byproduct Material License No. 04-13488-01 was issued in 1969 as a caretaker license for decontamination of buildings and packaging and storage of waste pending disposal during NRDL's closure. The license was terminated in 1970 (**HRA-1299**).

AEC Source Material License No. SMB-376 was issued prior to 1961; however, the timeframe is unknown. The license authorized use of radioactive source material in various studies and as calibration standards. The license was terminated in 1970 (**HRA-2786, HRA-2787**).

AEC Special Nuclear Material License No. SNM-35 was issued in 1959 and terminated in 1970. The license authorized studies using special nuclear materials (**HRA-2783**).

5.4 NON-LICENSED ACTIVITIES AT HPS INVOLVING RADIOACTIVE MATERIAL OR MACHINES THAT PRODUCE IONIZING RADIATION

In addition to the radioactive materials licensed by the AEC, NORM and NARM were used throughout the shipyard. These materials required special controls by Navy regulations; however, it was not controlled in the same manner as licensed radioactive materials. Additionally, small quantities of radioactive material, below levels controlled by the AEC, were also used in commodity items throughout the base, such as smoke detectors, deck markers, check sources for radiation survey instruments, and radioluminescent dials and gauges. Other radionuclides introduced to HPS were the unspent weapons material and fission products in samples brought back from atomic weapons testing. This material was considered "AEC material" and, while not specifically licensed, was subject to strict controls under the AEC and the Armed Forces Special Weapons Program.

Machines that produce ionizing radiation were used by the shipyard and NRDL. Generally, these machines did not use radioactive material or produce radioactive contamination. Controls for these types of equipment generally followed manufacturer's guidelines with the additional implementation of standard Navy requirements.

Use of non-AEC licensed materials and machine sources of ionizing radiation used by the shipyard and NRDL are described below.

5.4.1 HPS

NORM and non-specifically AEC controlled or licensed radioactive materials were used throughout the shipyard in commodity items. Specific examples include smoke detectors containing (americium-241 [Am-241]), exit signs (tritium [H-3]), sound-powered telephone jacks (Ra-226), deck markers (Ra-226 and strontium-90 [Sr-90]), electron tubes (many different radionuclides), thoriated welding rods (thorium-232 [Th-232]), divers' watches (Ra-226, H-3, and Pm-147), wristwatches and compasses (Ra-226, H-3, and Pm-147), and radiation detection equipment check sources (mainly cesium-137 [Cs-137], Sr-90, and Ra-226). Formalized controls for these items were not found, which is common because these controls were not typically warranted during the operational time of HPS.

Controlled disposal of radioactive commodity items began in the late 1960s when the Navy instituted a program to control devices containing Ra-226 that included removal of radium devices from ships and replacement with non-radium substitutes **(HRA-2932)**. In compliance, HPS implemented procedures for removal and control of devices containing radium **(HRA-2811)**. Gradually, the Navy expanded the control program to include all commodity items containing radioactive material. Prior to the implementation of the control programs, HPS likely disposed of these items as normal trash in the Landfill Area (IR-01/21) or Bay Fill Area (IR-02). Disposal of these items in commercial landfills was common practice by private industry as well.

Prior to 1950, gamma radiography was conducted using a Ra-226 source. By 1950, the Ra-226 sources were replaced by iridium-192 (Ir-192) and cobalt-60 (Co-60) sources, which were controlled by the AEC. Controls for radium were generally provided by the manufacturer until the Navy published its first controls in 1942 **(HRA-2930)**.

Machines that produce ionizing radiation (such as x-ray machines) were used for industrial and medical/dental applications at HPS. Use of these machines was not controlled by the AEC. While the Navy regulates use of this equipment today, historically controls were not implemented. These machines did not produce any residual radioactive materials, so their use is not addressed when determining impacted areas in Section 8.0.

5.4.2 Triple A

Definitive information is not available about Triple A controls on the use of radioactive material. Since Triple A was conducting the same type of work on Navy ships as HPS, it is likely that the same types of radioluminescent devices (containing Ra-226 or Sr-90) were removed and disposed of in the Landfill or Bay Fill Areas at HPS. Any controls Triple A used for the handling of these items have not been discovered; however, Navy manuals from the timeframe when Triple A leased the shipyard have been found in HPS buildings where these items were handled.

5.4.3 NRDL

NRDL also used NORM in their experiments and evaluated NORM usage in common commodity items. Uses of radioactive material in common commodity items were also assessed to study the impact on Navy personnel and equipment. Controls for these items generally followed the practices common at the time; although, when NRDL conducted research on commodity items, they usually developed the controls for those items.

NRDL used numerous machines that produced ionizing radiation. These machines ranged from small x-ray machines, to accelerators, to a cyclotron. Controls for these devices were developed from manufacturer's instructions, with additional safeguards established by the NRDL Health Physics Division. Buildings where these machines were used are addressed in Section 8.0.

NRDL did extensive work with AEC material that was not controlled by licensing. This included unspent weapons material and fission products collected at weapons test sites in the Pacific Ocean and at the Nevada Test Site. NRDL applied the same controls for this material as they used for AEC-licensed material.

5.5 FEDERAL REGULATORY AUTHORITY AND OVERSIGHT AT HPS

The following sections discuss the current regulatory agencies that oversee HPS. Each organization has distinct responsibilities. By agreement, federal agencies do not share jurisdiction over a site.

5.5.1 NRC

The NRC is the federal regulatory authority for use of source, special nuclear and byproduct material as defined in Title 10 of the CFR. Currently the Navy holds a NRC Master Materials License to cover use of NRC-licensed radioactive material by the Navy and Marine Corps.

In 1974, the NRC reviewed AEC license termination records for former HPS and NRDL facilities and found the previous termination efforts met the standards of the time. Since the former HPS facilities where radioactive material was used are now under the FUDS Program or within the property designated as an NPL site, oversight is provided by EPA and CDHS. The NRC no longer exercises direct authority over the residual contamination at HPS.

5.5.2 EPA

The EPA is a Federal agency that was established in 1970 to protect human health and to safeguard the natural environment (air, water, and land). The EPA is divided into 10 geographic regions; HPS falls under the jurisdiction of EPA Region 9. Each regional office is responsible for execution of EPA’s programs within that region. EPA works closely with other Federal agencies and state and local governments to enforce environmental regulations. While EPA sets environmental regulations, often the responsibilities for oversight activities are delegated to state offices. For HPS, the EPA oversees the radiological release of outdoor structures and open areas but defaults release of buildings to the CDHS. The EPA is a member of both the BRAC Cleanup

Team (BCT) and the Restoration Advisory Board (RAB). EPA regulatory programs at HPS are discussed below.

5.5.2.1 CERCLA

CERCLA (commonly known as Superfund) was enacted by Congress in 1980 and allows the EPA to:

- Establish prohibitions and requirements for closed and abandoned hazardous waste sites
- Hold the persons responsible for releases of hazardous waste at a site liable for cleanup of the site
- Establish a trust fund to provide for cleanup when a responsible party cannot be identified

The act authorizes two kinds of response actions:

Short-Term Removals, which are prompt responses to address releases or threatened releases.

Long-Term Remedial Responses, which are permanent actions taken to significantly reduce the danger of a release or threat of release of hazardous substances that are serious but not immediately life threatening.

CERCLA also enabled the revision of the NCP to provide guidance and procedures to respond to releases and threatened releases of hazardous substances, pollutants, or contaminants. This revision also established the NPL.

5.5.2.2 SARA

SARA amended CERCLA in 1986 and made significant changes to the program. These changes provided new enforcement authorities, including:

- Stressing the importance of permanent remedies and innovative technologies
- Considering other environmental laws and regulations
- Increasing state involvement
- Increasing the focus on human health problems
- Encouraging greater citizen participation in the decision-making process

SARA also required EPA to revise the Hazard Ranking System (HRS) to ensure accurate assessment of sites placed on the NPL.

5.5.2.3 NPL

CERCLA requires that the statutory criteria of the HRS be used to establish a list of national priorities of known or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States. The NPL is the result of this requirement. A tool used in the CERCLA process upon completion of the HRS, the NPL is an appendix of the NCP. Identification of a site for the NPL provides notification to the public that the EPA has determined that the site warrants further investigation to assess risks to human health and the environment and serves as notice to responsible parties that EPA may be seeking remedial action. Inclusion of a site on the NPL is not a judgment of the activities of the property owner nor does it require action or assign liability. The NPL primarily serves to identify a location where remedial actions appear to be warranted.

5.5.2.4 Major Steps in the CERCLA Process

The CERCLA process has been divided into the following series of steps:

- **PA:** A screening process to determine if further study is necessary
- **SI:** An on-site investigation to determine if there has been a release or a potential for a release and to determine any associated threats
- **RI:** A process generally taken by the responsible agency to determine the nature and extent of the problem associated with the release
- **Removal Actions:** An expedited action taken to remove a more immediate environmental threat or health hazard
- **FS:** Action taken by the lead agency to develop and evaluate options for remedial actions
- **Proposed Plan (PP):** Presentation of the nature and extent of contamination, alternatives evaluated, and preferred approach to remediation
- **Record of Decision (ROD):** A public document that describes the selected cleanup action
- **Remedial Design:** Technical analysis of the site remedy with detailed plans for implementation
- **Remedial Action:** Actual implementation of the cleanup

5.5.2.5 CERCLA and HPS

HPS was listed on the NPL in 1989, after an EPA review of the Navy IAS of HPS completed by the Naval Energy and Environmental Support Activity (NEESA) **(HRA-2969)**. In 1990, HPS was identified for closure and reuse under the Base Closure and Realignment Act. The Navy is proceeding with the CERCLA process for release of the site in coordination with EPA Region 9.

5.6 DoD

The DoD is the agency of the United States government that controls the Armed Forces and their properties. Two agencies of the DoD are involved in the assessment, cleanup, and release of HPS. The Navy is the lead agency because most of the property is still under Navy control. The Army is involved because four former HPS buildings and associated property are now privately owned. These four sites are identified as FUDS, which puts them under the jurisdiction of the USACE.

5.6.1 FUDS Property

DoD is committed to correcting residual environmental contamination caused by its activities. The Defense Environmental Restoration Program (DERP), established by CERCLA and SARA, is the vehicle used to accomplish this. The FUDS Program identifies properties contaminated with hazardous material that were formerly owned, leased, possessed, or operated by the DoD or its contractors prior to 1986 but are no longer controlled by DoD. The cleanup of FUDS is part of DERP. The Army has been assigned as the Executive Agency for the FUDS Program, and the USACE has been designated to manage and execute the FUDS Program. EPA works with USACE on these sites. FUDS properties associated with HPS include:

- **Buildings 830 and 831** and the associated 3.8 acres of land that was transferred to the University of California at San Francisco in 1978
- **Building 820** and the associated 2.3 acres of land that was transferred to Mr. Ted Lowpensky in 1981
- **Building 815** and the associated 4.2 acres of land that was transferred to Mr. Ted Lowpensky in 1984

Two other properties have recently been identified as having been associated with HPS but have not been officially listed under FUDS. These properties are not within the current confines of HPS. These areas include:

- **ICW 417, 418, 427, and 428.** These large warehouses are located approximately 2 miles from HPS and are now privately owned.
- **Buildings D-19, D-20, D-21, D-22, and D-23.** These warehouse-type structures, located just outside of the current HPS property, were used for storage by HPS. The structures were demolished in the early 1950s. The area where the structures were located has been totally renovated, including realignment of streets. It is now a housing area.

5.6.2 Navy

Because this volume of the HRA deals only with G-RAM, the Navy's regulatory involvement is addressed below.

5.6.2.1 NRSC

The NRC has granted the CNO a Master Materials License, which allows the Navy to administer and manage the use of licensed radioactive materials by the Navy and Marine Corps. To manage that license authority, the Navy established the Naval Radiation Safety Committee (NRSC) chaired by CNO N45 **(HRA-2933)**. The NRSC is supported by two technical support centers: the Navy Environmental Health Center, which manages medical uses of radioactive materials, and the NAVSEA Detachment, Radiological Affairs Support Office (NAVSEADET RASO), which manages industrial and operational uses. RASO is the Navy office providing support for radiological issues at HPS.

5.6.2.2 RASP

The CNO delegated responsibility for the safe uses of radioactive materials and machines that produce ionizing radiation to the NAVSEA. To implement the responsibilities for G-RAM, NAVSEA established the RASP **(HRA-2934)**. RASO provides technical support to NAVSEA for administration and management of the RASP.

5.6.2.3 IR Program

The Navy established the IR Program to implement the requirements of DERP and CERCLA. The purpose of the IR Program is to identify, investigate, and clean up or control releases of hazardous substances and to reduce the risk to human health and the environment from past waste disposal operations and hazardous materials spills on Navy and Marine Corps property in a cost-effective manner. The IR Program is managed by the Naval Facilities Engineering Command (NAVFAC). RASO provides technical expertise to NAVFAC for G-RAM issues associated with IR sites.

The IR Program manages Navy property closed under the BRAC Program. The specific manager for HPS is the SWDIV, which works with the EPA, as well as state and local agencies and the public, to ensure that all actions taken at HPS comply with CERCLA. NAVFAC uses a BCT that comprises representatives from all regulatory agencies and SWDIV to review ongoing and proposed actions at HPS with Navy representatives on a monthly basis. Additionally, representatives from regulatory agencies, the local community, activist groups, and the Navy comprise a RAB. The RAB meetings are held monthly to exchange information on environmental cleanup issues. The meetings are open to the public.

5.7 STATE OF CALIFORNIA

The State of California works with EPA and SWDIV to ensure that all aspects of CERCLA are implemented at HPS. The primary state agencies involved with HPS are detailed below.

5.7.1 CDHS

CDHS is the recognized authority on public health and a technical leader in scientific investigation. This department also implements the California Agreement State Radioactive Material Licensing Program. For HPS, EPA has deferred to CDHS for radiological release of buildings with contamination that does not have a pathway to the environment at the site.

5.7.2 DTSC

As a department of the California Environmental Protection Agency, the Department of Toxic Substances Control's (DTSC) mission is to protect Californians from exposure to hazardous wastes. DTSC is a member of the BCT and RAB and plays an integral role in overseeing the cleanup actions at HPS.

5.7.3 RWQCB

The Regional Water Quality Control Board (RWQCB) is a regional office of the California State Water Resources Control Board. The RWQCB develops and enforces water quality objectives and protects the beneficial uses of the state's waters. The RWQCB is a member of the BCT and the RAB.

5.8 CITY AND COUNTY OF SAN FRANCISCO

The City and County of San Francisco takes an active role in the ongoing CERCLA process at HPS. San Francisco is the prospective transferee of HPS from the Navy, provides representation on the RAB, and reviews all radiological actions at HPS.

5.9 LOCAL COMMUNITY

The local community, commonly known as Bayview, is actively involved in the regulatory process through representation on the RAB and its various subcommittees.

5.10 CURRENT CONTRACTORS

While the Navy has an NRC Master Materials License that would cover the residual radioactive material at the site, it is Navy policy that the contractor actually performing the work must maintain independent license authority.

Contractors performing current radiological work at HPS involving licensable quantities of radioactive material must have an NRC or a California Agreement State license for remediation, packaging, and transportation of any resultant waste. Since HPS is a federal property, any contractor performing radiological work under a California Agreement State license must file for reciprocity with the NRC before doing work at HPS.

All contractors performing radiological work at HPS prepare site work plans delineating proposed work efforts and safety measures. These work plans are reviewed by RASO and the appropriate regulatory agencies prior to initiation of work efforts. RASO also provides oversight during the work process and reviews all subsequent reports.

SECTION 5
TABLES

TABLE 5-1
ATOMIC ENERGY COMMISSION LICENSES
ASSOCIATED WITH HPS SORTED BY LICENSEE

AEC License No.	Licensee	Year of Issuance and Termination	Licensed Radionuclide(s)	Maximum Allowable Quantity	Purpose of Use
SNM-379	BUSHIPS	Issue: 1960 Term: 1967	Pu-239	0.15 µCi (20 sealed sources)	Instrument calibrations
SNM-397	BUSHIPS	Issue: Unknown Term: Unknown	Pu-239	3 µg in sealed planchettes	Unknown
08-00038-06	BUSHIPS	Issue: 1959 Term: unknown	Sr-90	800 µCi (8 sources of 100 µCi each) 5.1 µCi (17 sources of 0.3 µCi each) 12 µCi (12 sources of 1 µCi each) 3.02 mCi (20 sources) 1.36 mCi (34 40 µCi sources) 400 µCi, 480 µCi, 300 µCi (not to exceed 15 µCi per source) 250 µCi (40 0.7 mCi sources) 330 µCi (not to exceed 15 µCi per source)	Calibration of survey instruments and check sources for radiation survey instruments
			Cs-137	14 mCi (20 sources of 0.7 mCi each)	
08-00038-13	BUSHIPS	Issue: 1961 Term 1968	Pm-147	310 mCi (10 units of 31 mCi each) 100 mCi (5 units of 20 mCi each) 40 mCi (2 units of 20 mCi each) 310 mCi (10 units of 31 mCi each) 129 mCi (10 compasses of 25.8 mCi each) 16 mCi (10 watches of 4 mCi each (as written)	Experimental luminous markings on prototype submersible wristwatches and compasses
			H-3	450 mCi (3 compasses with no more than 150 mCi each)	
08-03978-8	BUSHIPS	Issue: Unknown Term: Unknown	Pm-147	27.9 Ci (1,800 wrist compasses with 15.5 mCi each)	Commodity for Navy-wide use
04-01039-02	HPNSY	Issue: 1959 Converted to AEC License No. 04-00364-09 in 1966	Co-60	30 Ci	Gamma radiography
			Ir-192	240 Ci	
			Cs-137	4 Ci	
04-01039-03	HPNSY	Issue: 1960 Incorporated into AEC License No. 04-00364-05 issued to SFBNSY	Co-60	14 Ci	Calibration of radiation detection instruments
			Sr-90	50 mCi	
			Cs-137	128 Ci	

**TABLE 5-1
ATOMIC ENERGY COMMISSION LICENSES
ASSOCIATED WITH HPS SORTED BY LICENSEE**

AEC License No.	Licensee	Year of Issuance and Termination	Licensed Radionuclide(s)	Maximum Allowable Quantity	Purpose of Use
04-00364-05	MINSY SFBNSY	Issue to MINSY in 1960. Amended in 1966 to include HPS under SFBNSY HPS removed in 1970	Co-60	14 Ci	Calibration of radiation detection instruments
			Sr-90	50 mCi	
			Cs-137	384 Ci (3 128 Ci Sources)	
04-00364-09	MINSY SFBNSY	Issued in 1966. Incorporated into AEC License No. 04-00364-06 to include HPS under SFBNSY	Co-60	30 Ci	Gamma radiography
			Ir-192	250 Ci (4 sources)	
04-00364-06	MINSY	Issued in 1959. Amended in 1966 to include HPS. HPS removed in 1974.	Co-60	50 Ci (4 sources)	Gamma radiography
			Ir-192	200 Ci (3 sources)	
04-13597-01	HPNSY	Issue: Unknown Terminated 1974	Co-60	20 Ci	Gamma radiography
			Ir-192	100 Ci	
04-13597-02	HPNSY	Issued as replacement for AEC License No. 04-00364-05. Terminated 1975.	Cs-137	128 Ci	Calibration of radiation detection instruments
04-00487-03	NRDL	Issued in 1958. Terminated in 1970.	Atomic Nos. 1 to 84	5 Ci each	Broad scope license managed by NRDL Radioisotope Committee
			Ac-227	10 mCi	
			Am-241	2 Ci sealed source 200 mCi	
			Am-243	1 mCi	
			Au-198	200 Ci	
			Ba-140	2,000 Ci	
			Br-82	50 Ci Special human use authorization	

TABLE 5-1
ATOMIC ENERGY COMMISSION LICENSES
ASSOCIATED WITH HPS SORTED BY LICENSEE

AEC License No.	Licensee	Year of Issuance and Termination	Licensed Radionuclide(s)	Maximum Allowable Quantity	Purpose of Use
04-00487-03	NRDL	Issued in 1958. Terminated in 1970.	Ce-144	2000 Ci	Broad scope license managed by NRDL Radioisotope Committee
			Cf-252	1 mCi	
			Co-60	25,000 Ci	
			Cm-244	1 mCi	
			Cr-51	20 Ci	
			Cs-137	20 Ci 3,000 Ci	
			H-3	500 Ci 4,000 Ci in accelerator targets Special human use authorization	
			Hg-203	10 Ci	
			Ir-192	500 Ci	
			K-40	Special human use authorization	
			La-140	2,000 Ci	
			Lu-177	2,000 Ci	
			Na-24	Special human use authorization	
			Np-237	10 mCi	
			Pm-147	200 Ci 10,000 Ci in oxide pellets and powder for SNAP fuel	
			Po-210	100 Ci	
			Po-Be	100 Ci	
			Rb-86	50 Ci	
			Sr-90	500 Ci	
			Sr-90/Y-90	60,000 Ci in two SNAP-21 capsules	
			Ta-182	10 Ci	
			Tm-170	8,000 Ci in alloy pellets for SNAP fuel	
			Tm-171	4,000 Ci in alloy pellets for SNAP fuel	
			Xe-133	2,000 Ci	
			Y-90	15 Ci	

TABLE 5-1
ATOMIC ENERGY COMMISSION LICENSES
ASSOCIATED WITH HPS SORTED BY LICENSEE

AEC License No.	Licensee	Year of Issuance and Termination	Licensed Radionuclide(s)	Maximum Allowable Quantity	Purpose of Use
04-00487-03	NRDL	Issued in 1958. Terminated in 1970.	Source and Special Nuclear Material	100 Ci of special irradiations of source and special nuclear materials (mixed fission products)	Broad scope license managed by NRDL Radioisotope Committee
04-00487-04	NRDL	Issued and expired in 1958	H-3	50 mCi	Human studies
			Br-82	9 mCi	
			K-42	3 mCi	
04-00487-05	NRDL	Issued and expired in 1958	La-140	500 Ci	Tracer studies at Camp Stoneman
04-00487-06	NRDL	Issued in 1961 Expired 1964	Any radioactive material	Total of 500 Ci per year later amended to 500 Ci per run	Packaging and disposal of radioactive waste at sea.
04-00487-07	NRDL	Issued and expired in 1961	H-3	50 mCi	Human use studies
			Na-24	No quantities available	
			Br-82	9 mCi	
			K-42	3 mCi	
04-00487-08	NRDL	Issued 1963 Term 1970	Co-60	15,000 Ci	High radiation intensity studies at Camp Parks radiation range
04-00487-09	NRDL	Issued in 1968. Material transferred to another licensee in 1969	Sr-90	66,000 Ci in 2 fuel pellets with uranium used as shielding	Fuel for SNAP fuel project
04-13488-01	NRDL	Issued in 1969. Terminated 1970.	Atomic Nos. 3 through 82	100 mCi in residual contamination in NRDL buildings	Caretaker license for decontamination of buildings, packaging, and storage pending disposal.
			H-3	10 mCi in residual contamination in NRDL buildings	
			Atomic Nos. 1 through 82	10 mCi contained in packages	
			H-3	1 µCi	
			Pa-234	0.01 µCi	
			Am-241	0.01 µCi	

TABLE 5-1
ATOMIC ENERGY COMMISSION LICENSES ASSOCIATED WITH HPS SORTED BY LICENSEE

AEC License No.	Licensee	Year of Issuance and Termination	Licensed Radionuclide(s)	Maximum Allowable Quantity	Purpose of Use
SMB-376	NRDL	Issued prior to 1961 – exact date unknown. Terminated 1970.	Natural uranium	50 lbs.	Ion exchange studies, calibration standards, thermal neutron activation analysis, and fission fragment tracks
			Natural thorium	10 lbs.	
			Depleted uranium (U-238)	2,426 lbs.	
SNM-35	NRDL	Issued in 1959. Terminated 1970	Pu-238	55 grams	Chemical and physical characteristics studies
			Pu-239	2,000 grams	
			Pu-Be	22 grams	
			PuF4	760 grams	
			U-233	30 grams	
			U-235	1,000 grams	
			U-236	0.1 grams	
			U-238	0.06 kg	
			Natural uranium	20 kg	
			Natural thorium	1 kg	
			H-3	0.001 grams	

6.0 HISTORY

This section presents a historical overview of HPS as it relates to the use of G-RAM. The history is augmented by the specific building use and area details presented in Section 8.0. For purposes of clarity, this history is divided into three operational areas. Though the history of the three operations is intertwined, each had distinct missions, impacts, and controls for the use of G-RAM. These three areas are:

- Known uses of G-RAM at HPS
- Operations at HPS associated with OPERATION CROSSROADS
- The RADLAB and NRDL

Radiological studies, surveys, and characterizations conducted at HPS since radiological activities began there in the late 1940s through June 2003 are summarized in this section. Survey and remedial actions after June 2003 are not included. These will be documented in separate reports.

Use of HPS facilities for nuclear-powered Navy vessels has been described in Volume I of the HRA and will not be duplicated in this assessment.

6.1 HPS

Original Drydock under Construction -- 1867

The area of San Francisco known as Hunters Point began its relationship with shipbuilding and repair to support the increasing demand for commercial trade and passenger travel brought on by the mid-19th century gold rush. In 1850, the Hunters Point peninsula was approximately 6,000 feet long and 2,000 feet wide, with a maximum elevation of 290 feet **(HRA-1119, p 3)**.

The peninsula sheltered a relatively deep anchorage on the protected side of the Bay. The first drydock at Hunters Point was completed in 1868. That drydock facility was privately owned and used by both commercial shipping customers and the Navy **(HRA-1119, pp 3, 4)**.

In 1903, a second drydock was built at Hunters Point. At the time, it was the largest drydock on the West Coast **(HRA-1119, p 7)**. Between 1909 and 1939, the facilities at Hunters Point were owned and operated by a Bethlehem Steel Company subsidiary and used extensively for commercial and military ship maintenance and repair. Throughout that period, the Navy negotiated lease agreements with Bethlehem Steel for priority use of the drydocks **(HRA-1119, p 14)**.

Hunters Point Drydocks in 1901

In the 1930s, the Navy recognized the need for additional ship repair facilities on the West Coast because MINS, the only Navy shipyard in the Bay area, had a shallow anchorage and limited room for expansion. However, the Navy was pressured to maintain the workload at MINS for economic and political reasons **(HRA-1119, pp 12, 23, 24)**. In 1939, after delaying the selection of a second shipyard site for a number of years, the Navy contracted with Bethlehem Steel to purchase the Hunters Point facilities **(HRA-1119, p 24)**.

Hunters Point Naval Shipyard – 18 November 1941

The 1939 purchase contract leased the facilities to Bethlehem Shipbuilding and Drydock Company to continue to operate the shipyard for 3 years. However, in light of pending military actions, the Navy terminated Bethlehem's lease in October 1941 and took full control of Hunters Point on 18 December 1941, 11 days after American entry into WW II **(HRA-1119, p 25)**.

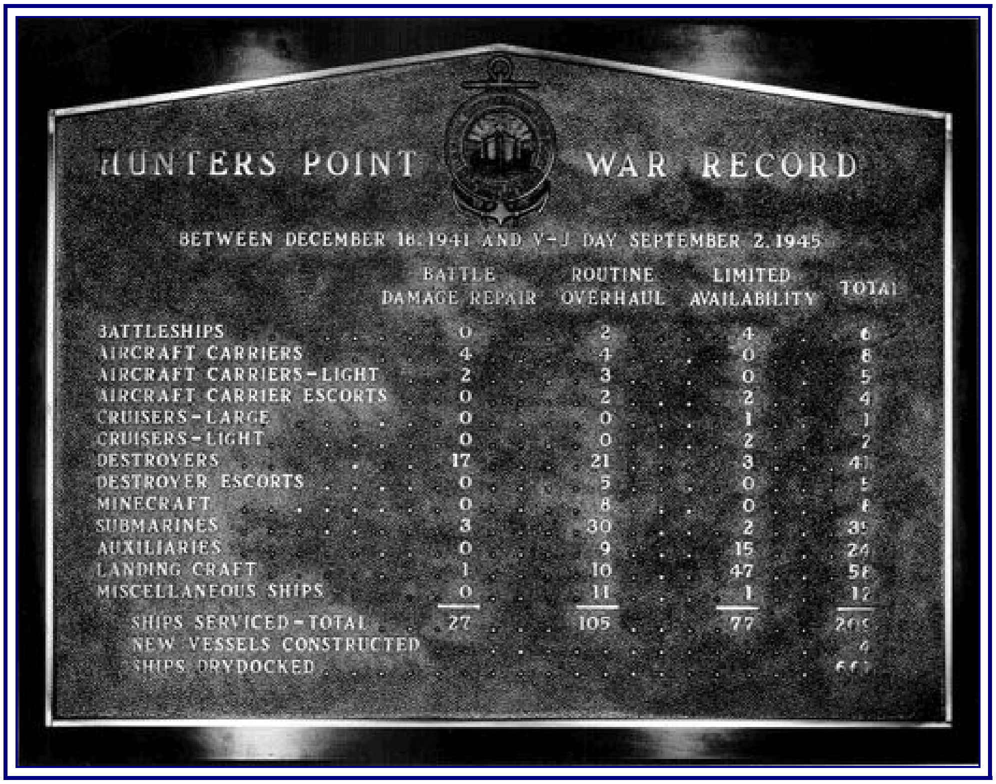
Significant improvements and construction began immediately to support the war effort. The Navy began excavation of the hills surrounding the yard, using the resulting spoils to expand the shoreline into the Bay. Quays, docks, and support buildings were built on an expedited wartime schedule to support the yard's mission of fleet repair and maintenance. A major expansion on the north side of the shipyard occurred during 1942 and 1943 when a submarine servicing facility consisting of drydocks and industrial and barracks buildings was completed **(HRA-1119, p 33)**.

As yard operations expanded, the need for skilled workers grew. HPS, known then as San Francisco Naval Shipyard, established apprenticeship programs for most of the shipyard trades and recruited personnel from all over the country to fill jobs created by the shipyard expansion. This influx of personnel greatly impacted growth of the surrounding area. Buildings were constructed to provide housing for workers and industrial support facilities for yard operations **(HRA-1119, p 37)**.

Hunters Point Naval Shipyard – 4 June 1942

Hunters Point Naval Shipyard – 3 November 1942

Over 40 percent of the buildings at HPS were built during WW II. However, despite the intensive construction and facility expansion, the shipyard serviced 209 ships and constructed 4 during the war for a total of 213 "dockings" **(HRA-1119, p 38)** (see photograph below).



Plaque Commemorating Hunters Point WW II Repair Record (Navy Photograph)

A unique WW II support function of HPS was the loading of components of the atomic weapon "Little Boy" that was eventually used on Hiroshima. This item was loaded on the USS INDIANAPOLIS on at 2:00 pm on 15 July 1945, and is reported to have contained half of the uranium-235 (U-235) available in the United States, valued at the time at $300 million. A top-secret convoy from Alamagordo, New Mexico, transported the weapon components to Kirtland Air Force Base. From Kirtland, the components were flown to San Francisco's Hamilton Field. The components were transported to a "safe house" at HPS, where they awaited the USS INDIANAPOLIS. The exact location of the "safe house" and the exact time the weapon components arrived have not been determined. Every security precaution was taken, including emptying all drydocks and berths at HPS, Marine security guards with automatic weapons, and planes flying surveillance over HPS. The USS INDIANAPOLIS left HPS at 6:30 am on 16 July 1945, but was not allowed to leave San Francisco's harbor until 8:30 am, after the first atomic weapon test "Trinity" had succeeded in the New Mexico desert **(HRA-1119, p 43)**. (For additional information, please see *In Harm's Way* by Doug Stanton, Henry Holt and Company, New York, 2001.)

Immediately after the end of WW II, the Navy used the expansive berthing facilities at HPS for reserve fleet ships returning from the Pacific. In 1946, this berthing was interrupted by the return of the Navy target and support ships from OPERATION CROSSROADS, two atomic tests conducted at Bikini Atoll in the South Pacific.

The return of these ships resulted in the creation of a special radiation safety office and program to manage the contaminated vessels **(HRA-1219)**. The impact of returning OPERATION CROSSROADS vessels on HPS was so significant that it is presented as a separate section, 6.2, below. The reserve fleet returned to HPS after work with the ships from OPERATION CROSSROADS was completed.

Drydock 4 - June 1953

By 1951, HPS shifted from operating as a general repair facility to specializing in submarine maintenance and repair **(HRA-1119, p 45)**. However, the Navy continued to operate Pacific Fleet carrier overhaul and ship maintenance repair facilities at HPS through the 1960s. Use of the shipyard began to decline steadily in the late 1960s and early 1970s because the Navy began using private shipyards to do work it had normally done in its own yards. As more work went to private yards, the primary mission of HPS continued on a diminishing basis until 1974 when the yard was disestablished as an active naval facility.

G-RAM was used at HPS throughout its use by the Navy. The use of G-RAM can be separated into broad categories of refurbishment and handling of radioluminescent devices, gamma radiography, calibration of radiation detection instruments, and decontamination of ships other than OPERATION CROSSROADS vessels. These activities are discussed in the following subsections.

6.1.1 Refurbishment and Handling of Radioluminescent Devices

Beginning in the late 1930s and continuing through the war years, radioluminescent devices and paint came into wide use in the Navy. Initially, dials and surfaces that needed to be illuminated without using electricity were coated with a radioluminescent compound, or paint, containing Ra-226 mixed with a base (for example, zinc sulfide) **(HRA-2930)**. This mixture would "scintillate" or glow when the base and Ra-226 (and its ionizing radiation) were mixed together. This radioluminescence allowed personnel to locate controls, gauges, and walkways during "darken ship" operations in aircraft or on drydocks or piers without the use of an external power source. Use of radioluminescent devices was common throughout Navy ships and the shipyard. These devices constituted the first G-RAM introduced to HPS.

Many Navy shipyards had radium paint shops that repaired and maintained radioluminescent devices in the 1940s, 1950s, and early 1960s. Historical research has not clearly established the location of the radium paint shop at HPS. However, Building 253, completed in 1947, has been described as the Electronics and Optical Shop since its construction. Electronic shops and instrument repair shops commonly worked with radium-bearing devices. Buildings 253 and 366 are associated with other radiological operations and have been identified as containing paint shops after 1949 (see Section 8.3). In view of the type of operations conducted in Buildings 253 and 366, it is likely that radioluminescent paint was used in those buildings.

The potential adverse health effects for personnel working with radium paint had been well document prior to the introduction of radium and radioluminescent devices to HPS. The earliest known Navy regulations and guidance for the protection of workers handling radioluminescent compounds appear in *General Safety Rules, Section No. 9*, published in January 1942 **(HRA-2930)**. Later, the Navy applied these same basic radiation safety principles to the use of other radioactive materials. These regulations continued to be improved over the years as knowledge about health effects of radioactive material evolved **(HRA-373; HRA-668; HRA-1096; HRA-1101)**.

In the late 1960s, the Navy began to implement stricter controls over the use of radium **(HRA-2931; HRA-2932)**. Radioluminescent devices containing radium were gradually phased out of the Navy programs, but records indicate that they were in use through at least 1971.

Starting in the early 1950s, other radionuclides, including Sr-90, H-3, and Pm-147, were used in radioluminescent devices. Sr-90 was primarily used in deck markers onboard ships. H-3 and Pm-147 were commonly used in diver's equipment, watches, and compasses. Although no specific documentation has been discovered, it can be reasonably assumed that control and disposal of these devices would have been done in a manner similar to those for radium devices because they were general commodity items and not controlled as radioactive waste.

Disposal of radioluminescent devices was not controlled by specific procedures until the late 1960s. Prior to that time, it was common practice throughout private industry and the military to dispose of radioluminescent instruments and articles by burial in landfills. Although no direct reference to burial at HPS was discovered during record searches, there are sufficient survey data and secondary reference materials to substantiate that this was the practice **(HRA-1602)**. This practice was confirmed through anecdotal information during interviews with former workers at the shipyard. Additionally, liquid waste containing radium was commonly disposed of via building drain systems to sewers **(HRA-667; HRA-668; HRA-220)**. It was also common practice to leave radioluminescent devices in place on equipment when it was sent to the salvage or scrap yard or processed through smelters.

Of the radionuclides used in radioluminescent devices, those still of concern are Ra-226 (1,599-year half-life) and Sr-90 (28.78-year half-life). H-3 (12.33-year half-life) would be of small concern since it is a gas and would most likely have dissipated by this time. Because of its short half-life (2.6 years), Pm-147 is not a radionuclide of concern at HPS.

HPS sites that could have been impacted by the refurbishment, disposal, or processing of equipment with radium devices are the HPS Landfill Area (IR-01/21); HPS Bay Fill Area (IR-02); Oil Reclamation Ponds Area (IR-03); HPS Scrap Yard (IR-04); HPS Salvage Yard (IR-12); the HPS Smelter (Building 408); and Buildings 146, 253, and 366. Building 146 was identified as a collection point for devices containing radium **(HRA-2811; HRA-2829)**. Storm, sewer, and drainage systems associated with buildings where radium paint was used are also potentially impacted.

6.1.2 Gamma Radiography

HPS saw its most productive period as an active industrial center from the end of the 1940s through the early 1960s **(HRA-119, p 45)**. During this time, the use of radioactive materials in commercial and industrial products expanded rapidly. One of the most important uses for radioactive materials during this era was industrial gamma radiography. A non-destructive testing (NDT) technique using a radioactive source, gamma radiography tests metals and welds similar to the way x-rays do diagnostic studies on humans (for example, chest x-rays).

Hunters Point Shipyard – September 1945

Gamma radiography uses a shielded containment device, usually called a "camera," to house a radioactive source. Using mechanical means, the source is exposed with the gamma rays from the source aimed at a material such as a pipe or weld. This makes an x-ray-like image on a piece of film. Through this process, flaws in the material could be seen on the film, much like a broken bone can be seen on an x-ray film. Gamma radiography became a standard NDT procedure throughout the country and was widely used at HPS.

The earliest devices for gamma radiography in industry and at HPS used Ra-226 sources. By the mid-1950s, Ir-192, Cs-137, and Co-60 sources were also being used for gamma radiography. Use of Ir-192, Cs-137, and Co-60 sources and associated gamma radiography equipment was authorized by specific AEC Byproduct Material Licenses after 1954. Ra-226, a naturally occurring radionuclide, was not controlled by the AEC. The AEC licenses defined requirements for the use, testing, storage, and transport of the gamma radiography sources, which were closely monitored and controlled. Specific AEC licenses for shipyard operations are described in Section 5.0, Regulatory Involvement.

Radioactive sources, including those in radiography devices, were found to leak radioactivity occasionally. Correcting the leak required return of the source to the manufacturer or disposal by regulated means **(HRA-14; HRA-138; HRA-237; HRA-2838)**. There is historic evidence of sources being repaired, resurveyed, and placed back into service **(HRA-322)**. There is no specific information as to whether cleanup actions were required or performed following the discovery of leaking sources, but leaking conditions were reported to the AEC **(HRA-2838)**. It is reasonable to assume that any needed cleanup was performed if the leaking source caused radioactive contamination to spread beyond the source container because this was common practice and necessary to eliminate future problems.

In addition to gamma radiography, x-ray radiography was a method of NDT used at the shipyard. X-ray radiography used an x-ray machine to generate penetrating radiation instead of a gamma-emitting radionuclide. The significant difference for the intent of this HRA is that x-ray machines do not create or use G-RAM and do not cause materials to become radioactively contaminated. Applying electricity to a special tube generates the x-rays, and when the electricity is turned off, radiation is no longer generated. Thus, there is no residual radioactivity from the use of x-radiography machines and no long-term impact from their use.

Gamma and x-ray radiography were commonly performed onboard ships and in buildings. Examples of specific sites where radiography equipment and sources were used, stored, and maintained include Buildings 113A, 146, 157, 214, 253, 351A, and 411 **(HRA-547; HRA-548; HRA-601; HRA-1472)**.

At the time of shipyard closure, all licensed gamma radiography sources and cameras were transferred to other licensed facilities or disposed of as radioactive waste at licensed disposal facilities **(HRA-1479)**.

6.1.3 Instrument Calibration

The shipyard used radiation detection instruments (commonly called Radiation Detection, Indication, and Computation instruments or "RADIAC" by the Navy) to monitor levels of and exposure to radiation. The use of these instruments was essential to the use of gamma or x-ray radiography equipment, decontamination efforts, and personnel monitoring as they were used to set up appropriate barriers to keep personnel away from radiography areas, confirm decontamination results, and monitor personnel exposures. The shipyard maintained and calibrated its own inventory of RADIACs. Ensuring a RADIAC's detection accuracy requires periodic calibration with a certified radiation source of a known quantity and frequent response checks using smaller sources.

In the early days of RADIAC use (the late 1940s and early 1950s), instrument calibration was done using a radioactive source in a lead-shielded container commonly referred to as a "pig." Calibration points were at measured distances from the pig with the door of the pig open to expose the source. An area on a floor would be painted to mark the levels a RADIAC should read at specific distances from an exposed source. This area was called a "calibration range." To calibrate an instrument, a technician would place it at the required calculated distance, open the door of the pig, and adjust the instrument to read the appropriate radiation level. As of this writing, the remains of calibration distance markings can still be seen on the third floor of Building 253, although the source and its pig are gone.

Specially designed calibrators replaced the primitive use of a source in a pig as technologies improved. These calibrators used various sealed sources, primarily Cs-137, Co-60, plutonium-239 (Pu-239), or Th-232, in specially designed shielded assemblies. These sources were licensed by the AEC and were routinely checked for leakage of radioactivity. If leakage was found, the calibrator would be removed from service until the source was repaired or replaced. If a source could not be repaired, it was disposed of as radioactive waste. All sources were either transferred to other licensed users or disposed of off site as radioactive waste when the shipyard closed. The AEC licenses held by the shipyard for the calibrators are detailed in Section 5.0. Available records indicate that calibration facilities used by the shipyard were maintained in Building 253 **(HRA-601, p 8)**.

Small check sources were available for checking the proper operation of RADIACs in the field. These were usually small sealed sources of a certified quantity of radioactive material, generally called check sources. Radionuclides commonly used for check sources were Cs-137, Co-60, Ra-226, and Th-232. Some of the check sources were maintained with the RADIAC and some were contained in source sets that allowed users to check the instrument for response to different types of radiation and the accuracy of that response. Most of the check sources did not require AEC licensing. These sources were disposed of off site as radioactive waste when they were no longer useful **(HRA-1044)**.

6.1.4 Decontamination of Ships

The drydock facilities of the shipyard were used in the late 1940s for decontamination of OPERATION CROSSROADS ships and periodically through the 1950s and 1960s for the decontamination of ex-GRANVILLE S. HALL (YAG-39) and ex-GEORGE EASTMAN (YAG-40). YAG-39 and YAG-40 were ex-Liberty ships specially modified to NRDL specifications to provide support for research during weapons tests in the Pacific. These vessels were decontaminated by the shipyard work force under the direction of NRDL. The details of OPERATION CROSSROADS decontamination efforts are in Section 6.2. The ships' use and decontamination are detailed in Section 6.3.

6.1.5 Non-Licensed Radioactive Commodities

Additional radioactive materials were commonly used throughout the shipyard in commodity items. These items include smoke detectors (Am-241), exit signs (H-3), electron tubes (variety of radionuclides), night vision equipment (Th-232), and thoriated tungsten welding rods (Th-232). Safety devices (smoke detectors and exit signs) remain in shipyard buildings today.

6.1.6 Triple A

From 1976 through 1986, major portions of the shipyard were leased to Triple A, a shipbuilding and repair company. Triple A did not possess radioactive materials licenses and likely subcontracted operations that required the use of licensed materials, such as gamma radiography **(HRA-2909)**. It is possible, based on the time period of Triple A operations, that shipboard devices containing Ra-226 and/or Sr-90 were removed and disposed of at the shipyard by Triple A. No historical documentation has been found that details Triple A radiological operations at the shipyard.

Though their lease expired in December 1986, Triple A did not vacate the shipyard until March 1987. During its tenure at the yard, Triple A sublet various buildings and grounds to a variety of individuals and businesses. Sublease agreements for building use with Triple A tenants remained in force after the Navy reclaimed the property in 1987.

6.1.7 Summary

The use of G-RAM at the shipyard is well documented throughout its history. HPS sites impacted by shipyard G-RAM use are detailed in Table 6-1.

6.2 HISTORY OF OPERATION CROSSROADS AND HPS

NOTE: The Defense Nuclear Agency report *OPERATION CROSSROADS 1946* has been included as reference **(HRA-578).** This document provides a detailed summary of OPERATION CROSSROADS and was the primary source of information for the following history.

The use of atomic weapons to end the war in the Pacific introduced a new field of science and new concerns for naval operations. To determine the effect an atomic weapon detonation would have on ships and personnel and to aid in the development of defensive measures to protect the fleet, the Navy made plans during late 1945 and early 1946 to test atomic weapons. This testing, organized and carried out under the command of Joint Task Force One (JTF-1), was given the code name OPERATION CROSSROADS. The conduct of OPERATION CROSSROADS and the resultant decontamination of ships that participated in the tests had a significant effect upon HPS

OPERATION CROSSROADS occurred in July 1946, when JTF-1 detonated two Nagasaki-sized atomic bombs (each had a yield of approximately 23,000 tons of trinitrotoluene [TNT]) in the lagoon of Bikini Atoll in the Marshall Islands. The task force included a total of approximately 42,000 personnel (5,000 civilian and 37,000 military) acting as monitors, observers, scientists, and general support. Almost all of the military were Navy personnel; most of whom were active duty, were stationed on more than 240 vessels used as either target or support ships.

OPERATION CROSSROADS consisted of two detonations: one air burst (Shot Able) on 1 July 1946, and one underwater burst (Shot Baker) on 25 July 1946. JTF-1 staged target ships at predetermined locations in the Bikini lagoon so the effects of the detonations could be evaluated. Many of the target vessels were committed to destruction or heavy damage by their placement during the test. Support ships were staged at distances that were estimated to be safe from the effects of the detonation but close enough to record the detonations and gather scientific data.

The Shot Able airburst caused extensive damage to many of the target ships. However, the detonation was nearly 0.5 mile from its intended target, the brightly painted battleship ex-NEVADA, and this affected the expected results. While damage to vessels near the blast was serious, the airburst did not generate much radioactive debris, sparing the ships from being heavily contaminated with radioactivity.

The Shot Baker underwater burst was far more damaging radiologically. A cable suspended the bomb approximately 60 feet under a specially modified barge. This setup ensured that the weapon would detonate on target. While extensive damage was expected from the detonation, the severity of radiological effects was not anticipated. The first effect of the blast was a tremendous bubble of water and steam that broke the ocean's surface. Then a huge wave, over 90 feet high, later called a base surge, rolled over target and support vessels as well as the islands of the atoll. Vast quantities of radioactive debris, primarily consisting of fission products (radioactive elements resulting from the fission, or splitting, of the bomb's plutonium), unconsumed plutonium from the bomb's fissioning core, and radioactive sand and coral that had been irradiated by the intense neutron radiation from the blast rained down on the target and support ships, islands, and lagoon. This unexpected outcome caused contamination of both target and support ships, the extent of which depended on each ship's position relative to the zero

Shot Baker Underwater Burst

point of the blast. Twelve of the ships in the immediate area of the detonation sank immediately or within hours. While support ships were affected by the base surge, the main source of contamination of the support ships was the contaminated waters of Bikini lagoon when the ships entered the lagoon to monitor or work on the target ships and processed the contaminated water through the ships' systems.

The heavy contamination of the remaining target ships and the subsequent contamination of the support vessels presented the Navy with an unplanned and unprecedented problem: the decontamination of hundreds of ships. Decontamination experiments were initially carried out at Bikini. These efforts primarily focused on the weather decks, underwater portions of the hull, saltwater systems, and evaporators. Evaporator systems had particularly high concentrations of fission products and plutonium. Even though ships' evaporator systems had been shut down for the test, a command decision to operate the evaporators in the contaminated lagoon to generate fresh water resulted in the systems becoming contaminated.

The remoteness of the test site, the lack of trained personnel and radiation monitoring equipment, and the extensive contamination caused lengthy delays, jeopardized the scientific purposes of the operation, and left the Navy with a fleet of ships incapacitated by radioactivity. Initially thought only to be contaminated with beta and gamma radiation from the fission products, the discovery of alpha contamination from the plutonium on the ships also caused the CNO and the BUMED a great deal of concern for the safety of Navy personnel working on the contaminated ships.

When it became apparent that radiological conditions at Bikini were hampering decontamination efforts, JTF-1 requested relocation of the primary decontamination effort. The CNO instructed the JTF to move decontamination operations to Kwajalein Atoll. Safe, or clearance levels, and decontamination procedures for the ships were debated and finally issued through BUSHIPS **(HRA-2641)**. The most heavily contaminated ships were sunk at Kwajalein, where surviving target ships and support vessels underwent preliminary decontamination. In short order, the Navy determined that shipyard facilities would be required to provide the necessary support and equipment to complete such a large-scale decontamination effort. The Navy also realized that expertise would be needed to develop methodologies to remove the contamination successfully. The Navy chose HPS as the principal location for the decontamination of OPERATION CROSSROADS ships because Navy technical knowledge in radiological science was centered there and the site was close to scientific expertise at the University of California at Berkeley and Stanford University. A listing of all OPERATION CROSSROADS ships is provided in Table 6-2.

Once the Navy determined that a shipyard environment would be needed, the target and support ships were returned to west coast ports. During the return, the ships' force continued decontamination efforts, disposing of removed contaminated materials at sea. These efforts included attempts to decontaminate saltwater systems, but only marginal success was achieved.

The most heavily contaminated ships were ordered to proceed to HPS **(HRA-1228)**. These ships were anchored at various locations in the Bay while experimental decontamination studies were performed by the RADLAB. These studies included determining health effects and radiation tolerance levels for personnel decontaminating the vessels, exploring methods to measure contamination and decontamination effectiveness, and investigating the most effective decontamination techniques. The RADLAB trained "monitors" who were responsible for assessing the levels of contamination on the ships at HPS and other shipyards.

BUSHIPS, with advice from BUMED, issued and updated clearance and tolerance limits to protect crews and workers from the hazards of the radioactive materials and radiation levels on the ships. Clearance standards were established at two levels: Operational Clearance and Final Clearance. In November 1946, these levels were defined as:

> "*Operational Clearance: indicates that all normal operations, repairs and maintenance can be carried out without radiological hazard provided the precautions set forth in Enclosure (A) for handling contaminated materials are observed. This is the clearance required for the normal operation of active ships.*"

> *"Final Clearance: indicates that no radiological hazard of any type, no matter how remote, exists on the ship and that further monitoring is not required. It will apply in like manner to operating ships and to ships destined for inactivation or disposal. Before final clearance can be granted, the monitors' reports and recommendations for such clearance must be forwarded to the Chief of the Bureau of Medicine and Surgery and the Chief of the Bureau of Ships, one complete set of reports to each Bureau. Inasmuch as this is the clearance required of all ships prior to inactivation or disposal, it is desirable that all ships satisfy the requirements for final clearance as early as possible."*

> *"Clearances are granted as follows:*
>
> *"Operational Clearance is granted by the Commander, Western Sea Frontier on recommendation of CWSF Clearance Board in accordance with safety tolerances and practices established by BUMED and in accordance with the procedures for clearance, monitoring and reporting established jointly by BUSHIPS-BUMED.*
>
> *Final Clearance is granted by BUSHIPS with the advice and concurrence of BUMED after review of the complete and final monitoring report for the individual ship."* **(HRA-642)**

The actual radiation levels that constituted clearance were given (*r* = rep, Roentgen equivalent physical, known today as *rem* [see Appendix A]. Readings are in *r* per day):

> *"(2) Operational clearance MAY be granted for urgent reasons when readings are:*
>
> *(a) Maximum shielded, between 0.1 and 0.001 r gamma*
>
> *(b) Maximum unshielded, between 0.5 and 0.005 r beta-gamma combined except underwater bodies with surface readings having statistical averages between 0.5 and 0.02 r beta-gamma combined.*
>
> *Operational clearance WILL be granted when readings are:*
>
> *(a) Maximum shielded, between 0.01 and 0.001 r gamma*
>
> *(b) Maximum, unshielded, between 0.5 and 0.005 r beta-gamma combined except hulls of ships external surface readings having statistical averages between 0.5 and 0.02 r beta-gamma combined.*
>
> *(3) Final Clearance will be granted when readings are:*
>
> *(a) Maximum, shielded, not above 0.001 r gamma*
>
> *(b) Maximum, unshielded, not above 0.005 r beta-gamma"* **(HRA-642)**

These limits, though more liberal than today's standards, were considered adequate protection for the health and safety of crews and workers at the time. More importantly, they reflected the instrument radioactivity detection limits of the period.

Uptake of radioactivity in the marine growth on the hulls and contamination of the saltwater piping of the ships were the most significant areas of contamination. Hull decontamination was performed in drydock, primarily using wet sandblast techniques. Saltwater piping was cleaned using various acid solutions. Initially, the sand and acid solutions were collected for disposal at sea. Sea disposal was defined as dumping at sea beyond the 100-fathom (600-foot) contour **(HRA-476)**. However, a BUSHIPS conference, held on 27 November 1946, concluded that **(HRA-578, p 142; HRA-596, pp 108-109)**:

> "Special disposal of sand used in sandblasting underwater bodies of radioactive contaminated nontarget ships is not required, provided marine growth is removed first and disposed of."

> "Solutions used in removal of radioactivity from saltwater systems of nontarget ships may be discharged into harbors, preferably at a slow rate or after dilution, without security or health hazard."

Based on the experience at HPS and the recommendations from the conference, JTF-1 issued a message on 4 December 1946 with the following guidance **(HRA-596, p 53)**:

- Wet sandblast media used for the decontamination of underwater bodies of nontarget vessels did not require special disposal.
- Sea disposal was required for marine growth and scale removed at first drydocking and scale and marine growth removed manually from evaporators and saltwater systems.
- Decontaminating solutions, including acids, used in cleaning saltwater systems could be discharged into the harbor. This was to be done during ebb tide well clear of docks and shorelines at a slow rate or by providing a flow of water so as to dilute the solutions by one-fourth.

Eighteen target ships and 61 support ships returned to HPS. The most heavily contaminated of these ships were the six target vessels that were towed to HPS because extensive damage prevented them from operating under their own power. The six target ships towed to HPS were the aircraft carrier ex-INDEPENDENCE (CVL-22), the attack transport ships ex-GASCONADE (APA-77) and ex-CRITTENDEN (APA-77), the submarines ex-SKATE (SS-305) and ex-SKIPJACK (SS-184), and the destroyer ex-HUGHES (DD-410). All of the ships but ex-HUGHES remained at HPS for research and decontamination. Ex-HUGHES was towed to Puget Sound Naval Shipyard in Bremerton, Washington **(HRA-578, pp 266-447; HRA-471)**.

Three of the towed target ships presented a special problem for the Navy; ex-INDEPENDENCE, ex-GASCONADE, and ex-CRITTENDEN contained radioactively contaminated fuel oil. This may have occurred on other ships that came back under their own power but the fuel would have been burned during the voyage back to HPS. The fuel oil of the three target ships was contaminated with low levels of plutonium and mixed fission products. Historical documentation does not detail how the fuel became contaminated. However, it is believed that the fuel may have become contaminated from the base surge and other effects of Shot Baker because fuel tanks and boiler systems were not sealed before the detonation.

Approximately 610,000 gallons of contaminated fuel oil from the ships was subsequently burned in the shore power/steam plants at HPS. The breakdown by ship was 274,000 gallons from ex-INDEPENDENCE; 84,000 gallons from ex-GASCONADE; and 252,000 gallons from ex-CRITTENDEN. Documentation only refers to the burning of the fuel oil in shore boilers. It is likely that the fuel was burned in the shipyard boilers in Buildings 203 and 521 **(HRA-1750; HRA-1538)**.

HPS conducted an initial test burn of fuel from ex-GASCONADE to prove the correctness of activity calculations and assumptions and to test the effects of the fuel burn on the boiler and the environment. However, records of the radioactivity measured in the oil from ex-GASCONADE have not been found **(HRA-1750)**.

Historical documentation of radioactivity content in the fuel was only found for ex-INDEPENDENCE. Calculations based on information contained in these documents show that the concentration of plutonium in the exhaust from the power plants would have been approximately 3.99×10^{-12} microcuries per cubic centimeter (µCi/cc) (see Appendix A). This concentration was less than 10 percent of the 1947 AEC tolerance level of 6.77×10^{-11} µCi/cc for exposure of a worker based on working 10 hours per day, 6 days per week for 1 year **(HRA-2935)**.

The fission product activity concentration in the ex-INDEPENDENCE fuel was given as a gross number, 7.2×10^{3} µCi in 274,000 gallons, **(HRA-2935)** so a direct comparison with individual radionuclide limits is not possible. The total airborne concentration due to fission products during the burning of the fuel oil is calculated to be 7.13×10^{-10} µCi/cc.

Based on the partial historical record available, it is estimated that the fuel burned during the months of April through August 1947. The maximum rate of fuel consumption through the boilers was given as 20,000 gallons per day. If the fuel was actually burned at this rate, a total burn time of at least 30.5 days through these months is probable **(HRA-1751; HRA-1753)**.

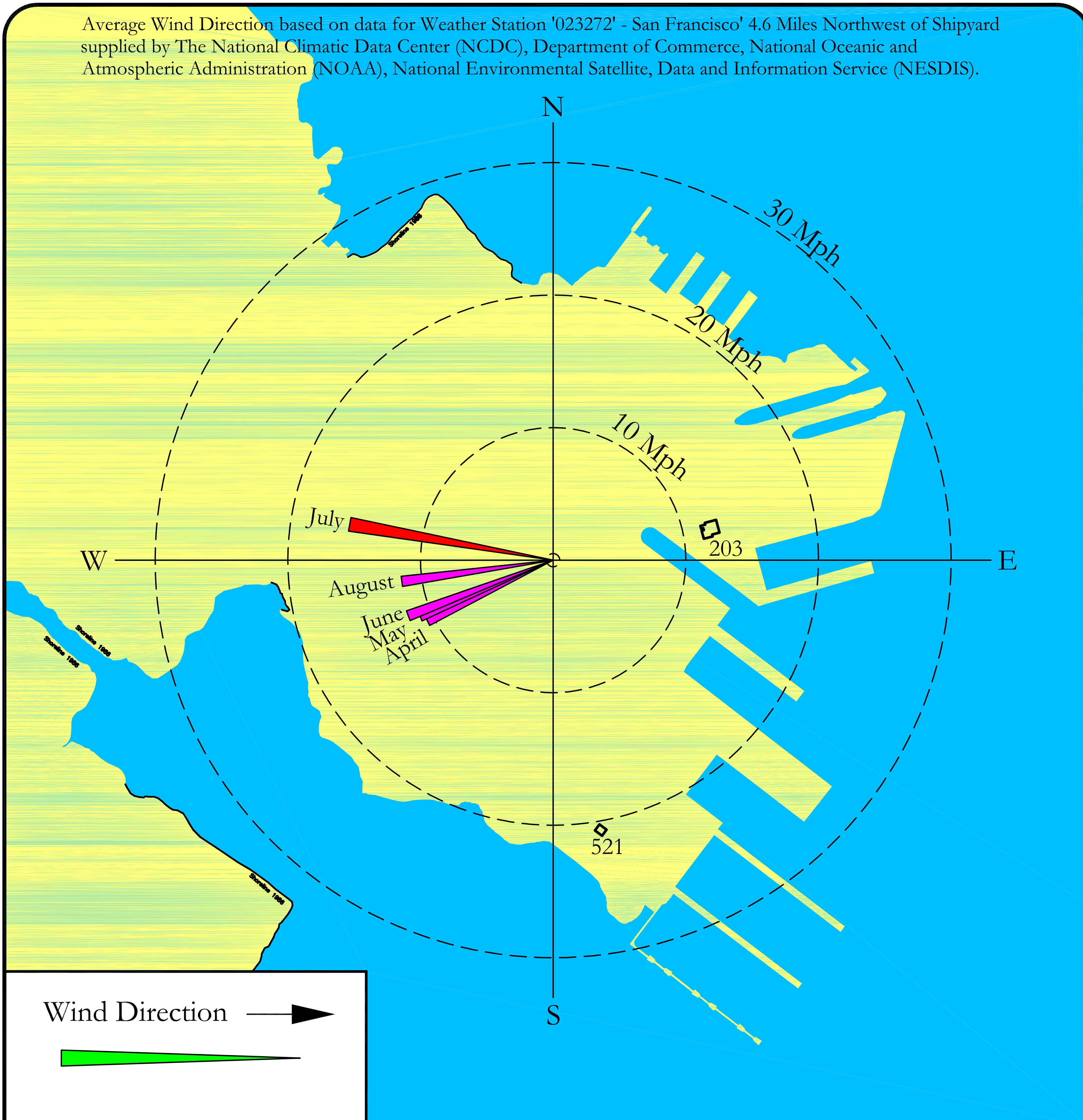
Safety precautions were established by BUSHIPS and BUMED for implementation during the burn **(HRA-492)**. They included:

- Maintaining excess air intake in the boiler as high as practicable
- Blowing soot frequently
- Burning only at high combustion rates
- Avoiding burning if raining
- Minimum handling equipment
- Checking tightness of boiler casings
- Monitoring of equipment when burning was complete
- Obtaining environmental samples at 0.25 mile from the boiler or at the farthest point of smoke from the boiler, whichever was greater, at the conclusion of burning

Because no information on results of the fuel oil analysis from ex-CRITTENDEN or ex-GASCONADE is available, the results from ex-INDEPENDENCE were used in the calculations for the inventory of fuel oil in all three ships. This is likely a conservative assumption since ex-INDEPENDENCE was closest to the test's zero point and would have been subjected to the most intense radioactive fallout.

Filter samples were obtained during burning operations. The boiler fireboxes and stacks were surveyed following burning. Wipes and residual fly ash were analyzed after the fuel was burned. Definitive results were not found in existing documents; however, statements from monthly reports stated that survey results were "In line with expectations, only low order activities have been found" **(HRA-1750 Encl B, p 3)**.

Historical research based on the estimated dates of fuel burning determined that the wind direction was generally from San Francisco out over the Bay. Figure 6.2.1 depicts wind direction during the period the fuel was burned. Tables 6-3A through 6-3E provide details on the daily weather conditions in San Francisco in 1947.



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Average Wind Speed (Mph)

- 30 - 35
- 25 - 30
- 20 - 25
- 15 - 20
- 10 - 15
- 5 - 10
- 0 - 5

Hunters Point
Naval Shipyard
San Francisco CA
Historical Radiological
Assessment
January, 2004

Figure 6.2.1
1947 Average Wind Conditions

As part of the final clearance process, it was also necessary to remove contaminated materials and equipment from the ships undergoing decontamination. Procedures that defined the clean limits for final clearance of the ships also applied to materials and equipment removed from them. Items to be removed, salvaged, or scrapped were identified and requests for monitoring and decontamination were processed **(HRA-354; HRA-491; HRA-523; HRA-1539; HRA-1693; HRA-1878)**.

Detailed radiological surveys were performed and reviewed to ensure these limits were not exceeded. Control of the materials prior to monitoring was important to the shipyard and control of contamination was of concern to the Navy **(HRA-1777; HRA-1885)**.

The materials were monitored on the ships and at dockside after removal from the ships, prior to release for reuse. No information has been found on release surveys from areas adjacent to the berthing spaces that contained removed contaminated materials.

By January 1947, 80 non-target ships had been granted final clearance. By the end of February 1947, the status of all OPERATION CROSSROADS non-target ships, including those at HPS, was:

Ships with final clearance:	128
Ships with operational clearance awaiting final clearance:	4
Ships with operational clearance but requiring further work:	3
Ships with neither clearance:	22
Ships destroyed following test Baker:	2

(HRA-578, p 142)

Eight ships remained at HPS to be decontaminated after December 1947. No details are available regarding the date that the final decontamination work was completed, but no mention of OPERATION CROSSROADS ships, other than ex-INDEPENDENCE, is found in available historical records after 1948. Further history of ex-INDEPENDENCE at HPS is detailed in Section 6.3, History of the NRDL.

Table 6-4 lists the sites at HPS that were impacted by work associated with OPERATION CROSSROADS.

6.3 HISTORY OF THE NRDL

As previously stated, the development and deployment of atomic weapons at the close of WW II had far-reaching impacts beyond the actual use of the weapons in Japan and in weapons tests. The military services recognized that changes would be required for both offensive and defensive measures in any future conflicts. Out of this need grew a requirement to study the effects of the atomic weapons on military personnel and assets and to develop defensive and protective measures for preservation of those personnel and assets.

To that end, the CNO responded in 1946 by ordering that an organization be developed and tasked with applying radiological safety within the Navy **(HRA-1219)**. This organization was first known as the RSS. The Navy determined that HPS was the most logical location to headquarter the RSS. The location of two major research universities with experience in experimental physics, the University of California at Berkeley and Stanford University, in the immediate San Francisco area was considered a significant advantage for locating the RSS at HPS **(HRA-587, p 1; HRA-1228, p 2)**. The RSS was placed administratively within the HPS Industrial Laboratory. Over the course of time, the RSS became known as the RADLAB **(HRA-1228, p 2; HRA-1486, p 2-30; HRA-1770; HRA-1819)**.

Original tasking for RSS included development of radiation detection instrumentation, equipment for protection of personnel onboard ships, and development of methods and equipment for decontamination of ships. All Bureaus of the Navy were assigned responsibility for support and implementation of the proposed organization. While the original charter was intended to support OPERATION CROSSROADS, the mission was soon expanded **(HRA-587, pp 2-5; HRA-1819)**.

The RADLAB responded to both directives and immediate circumstances by developing decontamination methods for OPERATION CROSSROADS ships. This included extensive research and experimentation on decontamination methods, personnel protection, and development of radiation detection instrumentation. The experimentation made the Navy realize, however, that research on the effects of atomic weapons was just beginning. Consequently, on 21 April 1948, the RADLAB was formalized as the NRDL with a greatly expanded mission **(HRA-587 p 3)**. The new responsibilities included practical and applied research into the effects of radiation on living organisms and on natural and synthetic materials, in addition to continued decontamination experimentation.

From an initial RSS staff of three in 1946, the NRDL personnel roster grew to 177 in January 1949 and to 200 by March 1949 **(HRA-10)**. NRDL's first dedicated building was Building 506, the former shipyard dispensary. But it soon became evident that this building was too small, and NRDL expanded into Buildings 507 and 510 in 1948 and Building 351 and additional Quonset buildings in 1949 **(HRA-587, p 19; HRA-1500, p 1; HRA-1752, p 3; HRA-1797 Encl A, pp 1-2)**.

6.3.1 1950-1969

By 23 January 1950, NRDL occupied ten buildings at HPS: Buildings 224, 313, 313A, 322, 351, 506, 507, 508, 510, and 701 **(HRA-20, pp 3-4)**. Research requirements were rapidly increasing, creating demand for additional space and personnel. With their functions growing disparate, NRDL was made a separate command from HPS on 1 October 1950 **(HRA-587, p 3)**. However, NRDL still reported through the Commanding Officer of HPS. Again, the laboratory mission was expanded to beyond the basic and applied research in radiation effects on materials, vessels, and personnel to include further development of defensive measures for ships, personnel, and shore installations **(HRA-587, pp 3-4)**.

**Ex-INDEPENDENCE Prior to Being Sunk in January 1951
(San Francisco Maritime National Historical Park,
National Park Service)**

Since its return from OPERATION CROSSROADS, the carrier ex-INDEPENDENCE was retained for use by the RADLAB and subsequently by NRDL for experimentation, testing of decontamination methods, storage of radioactive wastes, and as a dockside laboratory **(HRA-361, p 1; HRA-1639, p 2; HRA-1702; HRA-1708)**. In 1950, ex-INDEPENDENCE was docked at Berths 16 and 17 at the Regunning Pier (Gun Mole), where NRDL had a field laboratory that managed work on the carrier. This field laboratory eventually included a converted barge (YFNX-16), a decontamination pad, and personnel clothing change and decontamination facilities **(HRA-253; HRA-396)**. Ex-INDEPENDENCE, loaded with radioactive waste from NRDL and other generators, was towed to sea and sunk in January 1951 **(HRA-1424; HRA-1739; HRA-1910; HRA-1925; HRA-2721)**.

NRDL's barge and decontamination facilities remained on the Gun Mole until at least 31 December 1958. No specific records have been located concerning turnover of this area of the Gun Mole to the shipyard. However, there is evidence that, following the removal of the barge and decontamination pad, the Gun Mole was graded and resurfaced **(HRA-1106)**.

The health and safety of workers involved in work with radioactive materials were primary considerations of both the Navy in general and NRDL in particular. Throughout decontamination experiments and research activities, exposures were monitored and limits adjusted as the laboratory gained more knowledge and effects of exposure to radiation became better understood. BUSHIPS and BUMED implemented regulations and procedures throughout the Navy based on work done and knowledge gained at NRDL. While NRDL existed as a Navy facility, it also had units from the other military services attached to it. The same regulations and procedures developed for the Navy by NRDL often became common across the DoD **(HRA-587, pp 14-15)**.

Throughout the 1950s, NRDL was a unique and important entity recognized as a leading research facility in the country for study of nuclear safety **(HRA-2467)**. NRDL continued experimentation on the biological effects of exposure to radiation, decontamination technologies, radiation protection measures, nuclear warfare defensive measures, and fire protection. Many organizations, including the California Department of Public Health, California Highway Patrol, Office of Civil Defense, U.S. Public Health Service, and the AEC used the expertise of the laboratory and its personnel to develop regulations and controls governing the growing use of radioactive materials in the public sector **(HRA-1160)**.

As NRDL grew, so did its level of responsibility. In September 1955, NRDL was made a separate command with its own Officer in Charge. NRDL no longer reported through the Shipyard Commander but instead reported directly to BUMED and BUSHIPS **(HRA-423)**.

On-site technical support and research during nuclear weapons testing at the Nevada Test Site and Pacific Proving Grounds (Marshall Islands) comprised a large portion of the work done at NRDL during the time of atmospheric nuclear weapons tests. Laboratory personnel participated in every nuclear weapon test between 1950 and 1958 **(HRA-587, p 32)**. Personnel and equipment would be dispatched from the laboratory to the test sites to provide test support, such as overall radiation safety, collecting and processing of samples, personnel dosimetry, monitoring workers and equipment for radioactive contamination, and animal exposure experiments.

Two ex-Liberty ships, YAG-39 (ex-GEORGE EASTMAN) **(HRA-1215)** and YAG-40 (ex-GRANVILLE S. HALL) **(HRA-1218)**, were specifically modified through the period 1952 to 1955 to support and study the effects of atomic and nuclear weapons **(HRA-449; HRA-451; HRA-998)**. The two ships had a long history of use associated with NRDL and the Navy. The primary mission for them while assigned to NRDL was on-scene support and research during weapons tests in the Pacific. As was experienced with OPERATION CROSSROADS ships, the YAGs became radioactively contaminated when they were used at weapons tests **(HRA-461)**. They returned to HPS for decontamination, modification, repair, and storage when they were not in use. Documents indicate that decontamination operations were calculated with controls defined and imposed. A concentration limit for liquids of 1×10^{-5} µCi/cc "*specific activity*" (no definition of radionuclides) was imposed. Sandblast material was to be controlled (collected and drummed as radioactive waste) during removal of "hot spots" (not further defined). Once the hot spots were removed, the remaining sand could be disposed of in the Bay **(HRA-202; HRA-259)**. By 1956, a new directive regarding the disposal of liquids and sandblast material into the Bay stated that decontamination was to be "*witnessed by shipyard personnel to prevent runoff of contaminated liquids or dumping of contaminated wastes into bay waters at dockside. All* *contaminated wastes shall be disposed of in accordance with existing regulations*" **(HRA-165, p 2; HRA-461, p 5)**.

The YAGs were utilized for the basic mission of research and weapons test support through the late 1960s **(HRA-1527)**. YAG-40 was sold commercially in 1972, and YAG-39 was stricken from active service in 1975 **(HRA-1216; HRA-1237)**.

6.3.2 Radionuclide Use and Control

Because of the breadth of the research performed, NRDL used a large number of radionuclides. Prior to 1954, use of radionuclides was controlled, but not licensed, by the AEC. The RADLAB/NRDL established a working relationship with the AEC early in its existence and complied with the provisions of the AEA **(HRA-1284)**. The laboratory was required to acquire and control radionuclides through the AEC.

With the implementation of the AEC Licensing Program in 1954, the use of radioactive materials at the laboratory and at off-site test facilities operated by the laboratory was controlled by licenses issued by the AEC. The use of radium was an exception to the licensing requirement because radium was not regulated by the AEC but was controlled by the Navy. A complete listing of radionuclides used by the laboratory is included in Table 4-2. Table 5-1 details the specific licenses and the radionuclides authorized by those licenses.

NRDL was a pioneer in the development and use of radiation sources. The laboratory needed known radioactive sources to calibrate RADIACs and dosimetry devices such as film badges and pocket dosimeters. They used various sources for animal studies to simulate fallout and other tests and experiments. Sources were purchased from AEC-qualified vendors or created at a university or government laboratory engaged in such activities and authorized by the AEC **(HRA-1349; HRA-1353)**.

NRDL created individual sources from bulk quantities of isotopes. They would typically purchase the radioactive material from a vendor or another laboratory and would divide the material at NRDL for use there or for shipment to another, usually Navy, facility **(HRA-246; HRA-395)**. Most of these sources were short half-lived (less than 3 year half-life), but some had relatively long half-lives (for example, Ra-226, 1,599 years). Because these source materials were not sealed and were manipulated in the laboratory, they were subject to occasional spills. The Health Physics group maintained tight controls over these radioactive materials. Spills were decontaminated and material accountability maintained **(HRA-562, pp 2-6; HRA-565, pp 2, 15)**.

Sealed sources, purchased from AEC-qualified vendors, were relatively easy to control. These sources were routinely tested to detect leakage. If leakage was found, the source was returned to the vendor for repair or replacement, or disposed of as radioactive waste. When NRDL closed in 1969, remaining sealed sources either were returned to the vendor, sent to another Navy facility licensed for receipt, or disposed of as radioactive waste at an off-site, licensed disposal facility **(HRA-138; HRA-1044; HRA-1047; HRA-2772, p 19)**.

In addition to AEC license controls, NRDL established an AEC-mandated Radioisotope Committee (RIC) to manage the use of radioactive materials and machines that produced ionizing radiation at the laboratory. The committee, comprising senior members of the laboratory staff, had responsibility for enforcing safety directives, developing procedures and policies for NRDL, investigating spills of radioactive materials and personnel overexposures, and implementing corrective measures **(HRA-587, p 11)**.

NRDL also had a Health Physics Division to implement the requirements of the RIC by managing the Radiological Control Program, maintaining records, and providing investigative resources **(HRA-587, p 10)**. The Health Physics Division evaluated requests for experimental use of radioactive materials prior to submittal to the RIC for approval.

From the beginning, NRDL occupied many buildings at the shipyard. In March 1955, most of the NRDL's 600 staff members moved to Building 815, which had been specifically designed and constructed for NRDL **(HRA-587, 19-21; HRA-1327, p 5)**. After moving from buildings it formerly occupied, NRDL personnel surveyed them for residual radioactive materials. Surveys were done in Buildings 142, 224, 313, 313A, 322, 351, 351A, 366 (formerly known as 351B), 507, 508, 510, and 520. NRDL reviewed survey results and cleared these buildings prior to returning them to the shipyard once they met the release requirements of the period **(HRA-409;**

HRA-274; HRA-674; HRA-975; HRA-1073; HRA-1074). The HPS buildings used by NRDL are listed in Tables 6-5A (through 1955) and 6-5B (after 1955).

In some cases, for example Building 506, restrictions were placed on future activities, such as drain line removal and replacement, indicating there was concern that not all radioactive materials were recovered or removed **(HRA-275)**.

Building 815 was designed with laboratory operations defining the parameters for construction. Ventilation systems were filtered to preclude releases of airborne radioactive contaminants from the building to the environment. Source storage facilities were provided in the basement. Two 15,000-gallon underground liquid effluent holding tanks were located outside the building. Discharges of potentially radioactive liquid were captured in these tanks and tested to ensure they met contemporary release limits prior to discharge. Radioactive sources and samples used by individual laboratories were placed in heavily shielded and locked rooms within the building know as “caves” **(HRA-599)**.

Additional support facilities were constructed in the period following the move to Building 815. Building 816 was built to house the Van de Graaff generator **(HRA-2113)**. Buildings 830 and 831 were built to provide an environment to house a pathogen-free small animal colony **(HRA-557, p after p 10)**. A Co-60 irradiator was also installed and used in the hot cell in Building 364 for animal experimentation **(HRA-48, p 8)**.

The consolidation of activities in Building 815 did not include all activities of NRDL. Buildings 364, 365, 506,529, 707, 816, 820, 821, 830, 831, and ICW 418 were also used by NRDL until it closed in 1969 **(HRA-1517, p 2)**.

6.3.3 Other Radiation Generators

In addition to the use of radioactive isotopes, NRDL owned several machines that used electrical energy to generate radiation and charged particles. The following devices are known to have existed at NRDL:

- X-ray machines in Building 815
- Low-power neutron generator in Building 506
- A 600-kilovolt (kV) Kevatron particle accelerator in Building 510A
- A Van de Graaff particle accelerator in Building 816
- A Cyclotron particle accelerator in Building 820

These machines produced ionizing radiation (x-ray machines), low-energy (Kevatron), or high-energy particles (Van de Graaff and Cyclotron) only when they were energized. NRDL used these devices to calibrate instruments and to irradiate animals and materials. Details of the locations for these devices are in Section 8.0. Except for the Cyclotron, they were all fully functional during the period NRDL existed. The Cyclotron was constructed during the last few years of NRDL's existence **(HRA-47, p 1; HRA-50, p 1)**. It was only in the testing phase when NRDL was disestablished. It never generated a particle beam external to the machine nor did it ever operate at its full rated power **(HRA-1596)**.

Because these machines did not contain radioactive materials, they could not have impacted the buildings in which they were located by direct contamination. However, radioactive materials were used as targets for the particle generators, particularly the Van de Graaff and Kevatron generator. The primary isotope used as a target was H-3. There had been concerns about H-3 contamination at and around Building 816 where the Van de Graaff had been located. Surveys of this area were done in 1970 and 1993 **(HRA-2772, pp 9-10; HRA-576)**. The 1993 survey is discussed in Section 6.4.

6.3.4 Waste Disposal Operations

From the late 1940s through 1959, NRDL and HPS conducted radioactive waste disposal operations. NRDL accepted and consolidated waste from other military installations, as well as educational institutions, research laboratories, and the AEC, and packaged the wastes for disposal. NRDL then worked with HPS to load the containers onto barges and to ship the material to an ocean disposal site near the Farallon Islands. NRDL was the primary military agency disposing of waste at the Farallon Islands. Commercial agencies also disposed of waste there during this time period **(HRA-1156; HRA-1159; HRA-1238; HRA-1241; HRA-1278)**.

In general, the generator notified NRDL that they had waste for disposal. Funding documents and cost estimates were created. The waste materials that were shipped into HPS, were received and stored at the Building 707 waste storage area, also known as the "707 Triangle" because it was the triangle-shaped property bordered by "J" Street, "R" Street, and 6th Avenue. The waste packages primarily consisted of 55-gallon drums. However, concrete casks were also designed and used for disposal of larger items. Numerous types and forms of radionuclides and various experimental media were included in the waste. Carcasses of small animals used in research were packaged in drums; large ones were either packaged in larger containers or cut up and put into drums. Concrete was added to the waste to weight the drums. Once at the disposal location, the containers were off-loaded and sunk. Should a drum not sink, it was fired upon with rifles until it sank. If it could not be sunk, it was recovered and returned to HPS. Waste processing, packaging, and disposal activities were detailed in NRDL procedures **(HRA-590)**.

Complete historical records documenting the exact inventories of waste disposed of or the number of containers shipped from HPS was not found. However, several NRDL annual reports do provide some details **(HRA-561, p 29; HRA-562, p 11; HRA-563, pp 18-20; HRA-564, p 25; HRA-565, p 22)**. An NRDL letter of 1958 summarized a total of 1,780 tons of DoD waste dumped at sea from 1954 to August 1958 **(HRA-1350)**. An EPA report of 1980 estimates that 47,500 containers, mainly 55-gallon drums containing 13,500 curies of radioactive waste, primarily short-lived radioisotopes, were disposed of at the Farallon Islands from 1946 to 1970. The report includes waste from both NRDL and commercial shippers **(HRA-1243)**.

Waste disposal was conducted under AEC authorization. However, it was not formally licensed until 1959 shortly before NRDL stopped accepting waste from other entities and waste disposal operations were contracted to a commercial vendor **(HRA-1080; HRA-1085; HRA-1086; HRA-1087; HRA-1129; HRA-1333)**.

By 1958, commercial options for disposal of radioactive waste materials were being evaluated and recommended by NRDL. Contracts between NRDL and other generators for waste disposal were cancelled or not renewed with recommendations to contract with commercial sources for the service **(HRA-1085; HRA-1086; HRA-1087)**. For a period of time, disposal was administratively assigned to the Military Sea Transport Service (MSTS); however, MSTS failed to obtain a license for disposal activities, and the operation again fell to NRDL with the assistance of HPS for a short period of time during late 1959 and early 1960 **(HRA-213; HRA-1086; HRA-1113)**.

A 1961 procedure for disposal of radioactive wastes demonstrates an organized and detailed methodology for handling, storing, packaging, and disposing of wastes. It also states that ultimate disposal was to be done by a commercial vendor. Solid waste was to be processed and packaged at the waste handling area near Building 707. All radioactive liquid waste was collected from the various laboratories and processed in a liquid radioactive waste holding tank outside Building 364. Once the tank was full, acidic or basic waste was neutralized, if necessary, and disposed of through a commercial company that pumped the waste from the tank and removed it from HPS for further processing and disposal at an off-site licensed disposal facility **(HRA-590)**.

In addition to off-site waste disposal, small amounts of low-level radioactive liquids were authorized for release via the site drainage or sanitary sewer systems. Because it was permitted by regulations of the time, it is reasonable to assume that NRDL disposed of small amounts of low-level liquid effluents through the building drains. These releases would have included dilution to ensure that they met the AEC release limits **(HRA-1705)**.

6.3.5 Fallout Studies

One of the most significant areas of research at NRDL was the ongoing study of fallout. Fallout refers to the radioactive debris from an atomic or nuclear event such as the explosion of an atomic or nuclear (hydrogen) bomb. This radioactive debris is generally in three forms:

- The weapon’s fissions products or radioactive isotopes of the smaller elements produced when a large uranium or plutonium atom is split by neutrons freed in the chain reaction that creates the bomb’s explosive force
- Excess neutrons that are not consumed in sustaining the chain reaction but react with the materials in the air, ground, and water where the bomb is detonated to make them radioactive
- Uranium or plutonium from the bomb’s core that was not consumed in the fission process

When a bomb detonates, it creates intense heat, wind, and a debris cloud. If the blast is underwater (as in shot Baker), there is also a wall of highly contaminated water pushed out from the blast. This wall of water is called a base surge.

As the cloud (and base surge for an underwater explosion) expands away from the blast, the radioactive particles begin to cool and fall back to earth. This is why the material is called fallout. Larger particles fall close to the site of the detonation. Small particles are carried by the wind for distances based on their size. Some of them are so small that they spread far from the source. Thus, fallout from the explosion of a weapon (or a catastrophic accident like Chernobyl) can travel thousands of miles from its source.

Most of the radioactive isotopes in fallout have short half-lives; however, some of them are longer lived. Plutonium, for example, has a half-life of 24,000 years. Cs-137 (30-year half-life) is the easiest fallout radionuclide to detect today due to its predominance and relative insolubility in water. The long-lived isotopes are the ones that can be detected years after a nuclear event. These are the isotopes that remain a concern at HPS.

NRDL collected large quantities of fallout material at most U.S. atmospheric weapons tests. Sample collection ranged from small air sampler filters to large trays with thick layers of collected material. These samples were both counted in the field and returned to NRDL for further analyses. Based on the results of these analyses, the explosive yield of the weapon (measured in kilo- and megatons equivalent to TNT) could be determined.

NRDL scientists would process fallout samples to reduce them to a form that would suit the counting geometry. For example, samples would be dissolved in strong acid, neutralized, and dried before counting. Most sample preparation was done in filtered laboratory hoods. Large quantities of fallout material were collected and prepared by NRDL. Therefore, areas where it was handled are considered impacted.

Several interviewees remembered that after fallout samples were processed the remainder of the material was saved. Saved samples were stored in various shielded containers and rooms in NRDL facilities. When there was no further need for them, they were disposed of off site as radioactive waste. At NRDL’s closure in 1969, samples that remained in storage were disposed of as radioactive waste under the disposal criteria in place at that time (HRA-1100). Known sample storage locations are included in the impacted sites.

6.3.6 Animal Studies

Beginning with OPERATION CROSSROADS, various animals were used for research during the detonations. The use of animals as substitutes for human beings exposed to hazardous materials and environments is not unusual. To the planners of OPERATION CROSSROADS, they were a natural choice for the study of both radiological and physical bomb-induced effects (HRA-578, p 68).

From the beginning, the RSS, RADLAB, and NRDL used animals for experimentation. There were animal facilities at HPS and at Camp Parks, near Dublin, California. Typically, smaller animals were raised and kept at the shipyard and larger animals at Camp Parks. Over the years bees, moths, bats, mice, rats, cats, monkeys, mules, hamsters, guinea pigs, dogs, pigs, sheep, goats, burros, and cows were kept and used as subjects for a wide variety of research involving radioactivity and radioactive materials. Animal experimentation continued up to the disestablishment of NRDL in 1969.

At HPS, animals were raised and kept in animal pens near Building 704 and in Buildings 365, 506, 507, 517, 707, 708, 815, 830, and 831. NRDL purchased animals from vendors but also had breeding colonies to raise pathogen-free animals, especially in Buildings 815 and 830 (HRA-51, pp 9-10).

Animals were irradiated by use of the laboratory's x-ray machines. They also were exposed to high levels of radioactivity in sealed-source irradiators and injected with radioactive materials. Some were exposed to radionuclides to study the physiological changes induced by the radioactivity. Other experimental work involved extensive studies of liver function. Research animals were studied, sacrificed, and autopsied.

Carcasses of animals that were not radioactively contaminated were disposed of as waste, usually through a vendor who specialized in animal disposal, although there is evidence they were also discarded in the on-site landfill. An incinerator was constructed for use by NRDL for disposal of animal remains and wastes **(HRA-172, p 6)**.

The carcasses that had been dosed with radioactive material were considered radioactive waste and their disposal was carefully controlled. In the early days, they were drummed and buried at sea with other radioactive waste. When sea disposal was no longer an option, the radioactive carcasses were disposed of at a licensed off-site disposal facility with other radioactive waste **(HRA-590, p 5)**.

6.4 HISTORICAL RADIOLOGICAL INVESTIGATIONS, SURVEYS, AND STUDIES

Since the beginning of radiological operations at HPS in 1946, radiological investigations and removal actions have been conducted by various groups and regulatory agencies to assess and remove residual G-RAM resulting from these operations. NRDL, Navy contractors, regulatory agencies, and RASO have conducted various radiological surveys and studies to evaluate residual radioactive contamination and risks from radiological operations at HPS through the years. These investigations and surveys include:

- 1946 through 1948 RSS and NRDL surveys and decontamination of OPERATION CROSSROADS ships and drydocks
- 1955 NRDL surveys to decommission NRDL buildings at HPS
- 1969 NRDL survey for disestablishment of NRDL
- 1969 to 1970 AEC survey to verify NRDL's survey results and release buildings for reuse
- 1974 HPS survey for base closure
- April 1978 LFE Environmental Analysis Laboratories, Inc. (LFE), survey of Building 815
- July 1978 RASO survey of Building 815 to confirm LFE survey findings
- September 1978 RASO survey of former NRDL buildings
- 1979 RASO resurvey of Buildings 364, 815, and 816
- 1986 EPA harbor survey at NNPP request

- 1988 to 1989 Harding Lawson Associates (HLA) site reconnaissance
- 1991 to 2001 surveys conducted for the RI program in four phases: Phases I through IV, including the following interim investigations:
  - 1997 Parcel E radiation risk assessment
  - 1999 to 2001 interim investigations between the Phase IV and Phase V investigations
  - 2001 to 2003 Phase V investigations and removal actions

6.4.1 1946 through 1948 OPERATION CROSSROADS Surveys

OPERATION CROSSROADS ships were decontaminated from 1946 to 1948 at Drydocks 3, 4, and 6 and various berthing spaces. BUMED, BUSHIPS, and RSS personnel coordinated the decontamination, monitoring, and clearance of ships exposed during OPERATION CROSSROADS tests. After each ship was decontaminated, Navy personnel performed a radiological survey and decontamination of the drydock **(HRA-454; HRA-471; HRA-506)**.

The most effective decontamination method was sandblasting the contaminated surfaces of a vessel. In general, spent sandblast wastes containing "all rust and marine growth" were containerized and disposed of by ocean disposal. Other spent sandblast materials and decontamination solutions were authorized for disposal to the Bay **(HRA-454; HRA-471)**. During 1946 and 1947, radioactive wastes from these activities were disposed of in an approved zone at least 10 miles at sea, or beyond the 100-fathom curve (contour line indicating an ocean depth of 600 feet). After removal of the sand, the drydock floor was washed down vigorously and the water pumped into the harbor. Surveys of the drydocks were performed after undocking of the ship **(HRA-454; HRA-471; HRA-506)**.

Documents from 1947 indicate that Drydocks 3, 4, and 6 were at background levels when surveyed by Navy personnel, except for two anomalies found at Drydock 4. However, they met the cleanup criteria for release using radiation detection instruments available at the time **(HRA-206; HRA-509)**.

6.4.2 1955 NRDL Surveys

In March 1955, NRDL consolidated most of its facilities into Building 815 and surveyed the buildings it formerly used for free release to the shipyard's use and control. Surveys were conducted in Buildings 313, 313A, 322, 351, 351A, 366 (formerly known as 351B), 506, 507, 508, and 510. The NRDL release letters confirm that these buildings were surveyed and released for unrestricted use in 1955 during the transfer of operations to Building 815 **(HRA-223; HRA-224; HRA-225; HRA-227; HRA-275; HRA-304; HRA-305; HRA-674; HRA-1073; HRA-1074; HRA-105)**. Buildings 506 and 351A were released with the following caveats regarding the pipes and the sanitary sewer system **(HRA-275; HRA-305)**:

- A radiation monitor must accompany working parties on the sewer systems for on-the-job monitoring until the present drain lines are replaced.
- Drain lines removed from Building 351A in the future must be disposed of as low-level radioactive waste so they will not be reused.

No site-specific survey or decontamination procedure was found for the 1955 NRDL surveys. However, under existing AEC guidelines, all NRDL buildings were required to be thoroughly surveyed and decontaminated prior to abandonment or release for unrestricted use. For final clearance, former NRDL facilities were required to meet the residual contamination levels established by BUMED for decontamination of Navy facilities and equipment. The release limits as stated in the memo are:

> *"Gamma contact dose rate less than 1.8 mR/hr*
> *Beta dose rate less than 9 mrep/hr*
> *Fixed beta-gamma contamination less than 10,000 d/m/cm^2*
> *Removable beta-gamma contamination less than 4,000 d/m/cm^2 by a wipe test*
> *Fixed alpha contamination less than 500 d/m/cm^2*
> *Removable alpha contamination less than 1 d/m/cm^2"* **(HRA-304)**.

Note: Terms in the above are defined as:
mR/hr – millirem per hour
mrep/hr – milliroentgen equivalent physical per hour
d/m/cm^2 – disintegration per minute per square centimeter

6.4.3 1969 NRDL Survey for Disestablishment

On 25 April 1969, Navy's Chief of Naval Material issued a letter announcing that NRDL would be closed ("disestablished" in Navy terms) by December 1969 **(HRA-1597)**. All radiological operations were suspended. Surveys were performed in areas where G-RAM-related operations were conducted to ensure applicable radiological release criteria were met.

Termination of the AEC licenses required the transfer of all G-RAM sources to other licensed operations or disposal at a licensed off-site disposal facility. In addition, all areas involving G-RAM-related operations occupied by NRDL required decontamination, if necessary, to reduce radioactivity to acceptable levels for unrestricted use. The NRDL Health Physics Division surveyed and decontaminated Buildings 364, 506, 529, 707, 815, and 816 **(HRA-1479)**.

The surveys consisted of measuring alpha and beta-gamma radiation levels and collecting swipe samples to detect removable contamination. Any NRDL areas found to be radioactively contaminated were further decontaminated. In general, decontamination was accomplished by:

- Removal of all radioactive source material
- Measurement of external radiation levels
- Swipe sampling of all areas involving G-RAM-related activities
- Decontamination by washing or scrubbing with detergents, dilute complexing agents, mild acids, or combinations of the above
- Chipping, sandblasting, vacuuming, and high-pressure steam cleaning
- Dismantling of radioactive equipment that could not be readily decontaminated using the procedures discussed above and disposal at a licensed radioactive waste disposal facility

The AEC Division of Compliance conducted a final inspection of all areas monitored and decontaminated by NRDL **(HRA-1479, pp 19-20)**.

A localized contaminated area was considered decontaminated by the AEC when the gamma dose rate at 1 centimeter above the surface averaged less than 0.2 millirem per hour (mrem/hr) and the removable activity per 100 square centimeters of surface area was less than

1,000 disintegrations per minute (dpm) beta-gamma. For alpha contamination, a localized contaminated area was considered decontaminated when the fixed activity was less than 500 dpm per 100 square centimeters (500 dpm/100 cm^2) and the removable activity was less than 100 dpm (HRA-1479, p 4).

Decontamination and removal actions conducted at each former NRDL building are summarized below.

- **Building 364** – Radioactive liquids in the two holding tanks in the yard area were pumped into a tank truck and removed by a commercial contractor. The tanks were then removed from the pit and disposed of as radioactive waste. The pit was decontaminated by chipping the surface concrete until radiation levels and swipe sample analyses were below AEC-mandated levels. The pump shed and all associated plumbing, as well as all plumbing from Building 364 to the tank pit, were removed except for one pipe leading to a concrete slab. AEC recommended leaving that pipe in place and filling the pipe excavation with concrete. The walls of Room 108 were washed with detergent (HRA-1479, pp 15-16).

- **Building 506** – The stainless steel holding tank on the north side of the building was decontaminated three times before acceptable radiation/contamination levels were obtained. The tank was removed by the shipyard and used for boiler feed water storage. All contaminated equipment in Rooms 35 and 35A was either disposed of as radioactive waste at a licensed off-site disposal facility or crated and shipped off site as radioactive material to another licensed facility that could make use of the equipment. Rooms 35 and 35A were washed with hot water and steam cleaned to remove residual contamination. Rooms 33 and 33A contained several localized areas of H-3 contamination that were scrubbed with decontamination detergent. The filter housing on the roof was removed and disposed of off site as radioactive waste (HRA-1479, pp 13-14).

- **Building 529** – Radiological surveys and swipe sampling were conducted. The results showed no detectable radiation (HRA-1479, p 14).

- **Building 707** – Building was surveyed and decontaminated to background levels and released by NRDL for unrestricted use in 1969 (HRA-1479, p 4).

- **Building 815** – Each floor of Building 815 was decontaminated by washing affected areas and dismantling radioactive equipment, which was then packaged and disposed of off site. Areas were released after final surveys found no contamination at or above release levels. Two storage tanks on the west end of the building were cleaned by rinsing with a fire hose. One tank was then filled with water, and a sample of the water was collected. When alpha, beta, and gamma radiation were not detected in water, it was transferred to the second tank. The water from the second tank was sampled and also tested for alpha, beta, and gamma radioactivity. When no contamination greater then release levels was found, the tanks were released as clean **(HRA-1479, pp 4-9)**.

- **Building 816** – The Van de Graaff generator was removed and shipped to the Naval Ammunition Depot in Crane, Indiana, for reuse. The building was steam cleaned. Survey results showed that H-3 contamination had been successfully removed **(HRA-1479, pp 9-10)**.

No material remaining in Buildings 364, 506, 529, 815, or 816 yielded detectable levels of radioactivity that exceeded the release limits using detection equipment available at that time. Isolated areas of residual radioactivity remained in the vicinity outside of Building 364 after decontamination was completed, but radioactivity levels were well below AEC's maximum permissible concentrations. Radioactivity was detected in the yard behind Building 364, primarily on the floor of the concrete tank pit and on the demolished shack floor slab. Also, the remaining pipe under the Building 364 concrete slab had a reading of 0.5 mrem/hr **(HRA-1479, p 16)**.

6.4.4 1969 to 1970 AEC Surveys

From 15 September 1969, through 30 January 1970, AEC visited HPS 22 times to conduct confirmatory surveys of facilities previously used or being vacated by NRDL. The surveys included Buildings 364 (and the yard), 365, 506, 517 (containing the Co-60 irradiation room), 529, 815, and 816 and the Building 707 area concrete waste preparation pad **(HRA-1038)**. Documentation showed that no G-RAM was housed in Buildings 820 and 821; therefore, AEC release for these buildings was not required **(HRA-1479, p 20)**.

AEC granted final clearance based on an independent survey consisting of spot checks for radioactivity in areas previously cleared by the NRDL Health Physics Division. The surveys included measuring alpha, beta, and gamma radiation levels and swipe sampling to test for removable contamination. Alpha readings were taken only in areas where alpha contamination may have occurred, which included the sixth floor and rooms 179, 222, 218, 218A, 1109, 4125, 4129, and 4181 of Building 815. The liquid waste storage tank pit behind Building 364 was also surveyed for alpha contamination. Swipe samples from these locations were counted for beta-gamma, and samples showing 100 dpm or more were then counted for alpha levels **(HRA-1038)**.

The survey results demonstrated that the former NRDL facilities met permitted regulatory levels (called *de minimis*) required for release for unrestricted use **(HRA-1038; HRA-2998)**. These levels were as follows:

- Average beta-gamma dose rate at 1 centimeter above the surface less than 0.2 mrem/hr
- Beta-gamma removable activity less than 1,000 dpm/100 cm^2
- Alpha fixed activity less than 500 dpm/100 cm^2
- Alpha removable activity less than 100 dpm/100 cm^2

Several areas were identified as containing residual radioactivity exceeding the above limits, but additional controls were put in place prior to AEC acceptance of the release surveys. The drain in Building 364 (which read 0.07 mR/hr) was filled with concrete and remained in place after release **(HRA-1479, p 16)**.

AEC's final report documented release of Buildings 364, 365, 506, 517, 529, 815, 816, and 707 and ICW 418 **(HRA-1038)**.

6.4.5 1974 HPS Survey for Base Closure

HPS was disestablished in 1974. All radiological operations conducted by the shipyard were suspended. Surveys were required to ensure that areas where licensed G-RAM-related operations were conducted met applicable radiological release criteria. All shipyard facilities involving G-RAM-related operations were decontaminated as necessary and surveyed prior to release. However, available documentation does not indicate survey or decontamination procedures. Known information is summarized below.

In August 1974, the shipyard surveyed Buildings 113A, 146, 214, 253, and 351A for residual contamination. These buildings were released for unrestricted use based on the survey results **(HRA-2964)**.

At Building 351A, shipyard personnel collected swipe samples and took direct radiation reading measurements. Beta contamination was discovered in the sink and associated drain lines in Workroom 47. The sink was removed, and the building was released for unrestricted use.

6.4.6 April 1978 LFE Survey of Building 815

In April 1978, LFE conducted an independent characterization survey at Building 815 to assess potential residual G-RAM. NRC's allowable radiation levels changed between 1969 and 1978, and the survey was conducted at the request of the General Services Administration (GSA). GSA was interested in using the building and wanted to ensure it met the revised limits. The characterization survey consisted of alpha, beta, and gamma scans of each room in Building 815. Swipe samples were also collected at 76 locations for gamma spectral analysis. The results of the survey are summarized below **(HRA-2957)**.

- Room 1109 required more extensive decontamination. Heating and air ducts were contaminated with Cs-137. The survey report recommended further investigation and decontamination.
- Levels found in the fume hood ducts slightly exceeded room background levels. The report recommended that the ducts be sealed off or removed.
- Anomalies were detected on a desk in Room 135, a sink in Room 218, a bench in Room 471, tiles in Room 631, and the fume hood in Room 670. The survey report recommended that the desk, sink, bench, and tiles be either discarded or decontaminated and that the fume hood be either decontaminated or painted to fix the residual G-RAM in place and the location noted.

6.4.7 July 1978 RASO Survey of Building 815

On 27 and 28 July 1978, RASO conducted a radiological survey to validate LFE's survey results for Building 815. RASO's survey of Building 815 focused on the rooms identified by LFE as containing residual G-RAM. RASO also surveyed other randomly selected rooms and the heating and air conditioning system. The survey consisted of beta-gamma and alpha scans and swipe sampling for removable alpha and beta-gamma activity. Swipe samples were collected from 247 points in 22 different locations throughout the building. A powdery substance from ceiling air conditioning and heating intakes at various locations was also sampled **(HRA-3001)**.

Based on the new release limits published in *AEC Regulatory Guide 1.86 (June 1974)* **(HRA-2939)**, Building 815 contained isolated "hot spots" in ducts that served identified G-RAM use locations and other limited locations. Eight of the 247 locations surveyed indicated results exceeding these release limits **(HRA-3001, pp 3-4)**.

RASO recommended a more detailed investigation of G-RAM use locations. Further recommendations included **(HRA-3001, pp 4-5)**:

- Detailed beta-gamma radiological surveys of all rooms on the fourth, fifth, and sixth floors; Health Physics Division Rooms 218, 222, 255, and 2153 on the second floor; and Room 1109 on the first floor.
- Random alpha surveys of all rooms on the sixth floor and detailed alpha surveys in rooms where radioactivity levels approached acceptable limits.
- Evaluation of each air conditioning and heating duct intake and exhaust, fan blades, and filter areas for air handling units serving areas identified as requiring a more detailed survey.

6.4.8 September 1978 RASO Surveys of Other NRDL Buildings

After the confirmation that residual G-RAM levels at Building 815 exceeded the revised NRC allowable limits, RASO conducted cursory surveys at other former facilities that potentially could exceed the revised contamination limits **(HRA-3002)**. On 30 September and 1 October 1978, RASO surveyed Buildings 113A, 364, 365, 506, 517, 529, 707, and 816. The surveys consisted of alpha and beta-gamma scans and swipe sampling for alpha and beta-gamma activity. Soil, paint scrapings, wood scrapings, and other bulk samples were collected for radionuclide content analysis.

Radioactivity levels were less than the instrument minimum detectable activity (MDA) of 64 dpm in Buildings 113A, 365, 517, 529, 707, and 816. Building 364 still contained G-RAM at levels exceeding BUMED limits and NRC guidelines. The building was recommended for further investigation. In addition, three isolated spots with beta-gamma activity were detected in

Building 506, but the activity was well below NRC guidelines. A total of 267 cubic feet of waste packed in ten 55-gallon drums and two 6-by-4-by-4-foot plywood boxes were generated. Southwest Nuclear Company of Pleasanton, California, removed the waste for disposal.

6.4.9 1979 RASO Resurvey of Buildings 364, 815, and 816

Based on 1978 survey recommendations, RASO conducted additional surveys at Buildings 364, 815, and 816 in 1979 to assess whether they still met NRC's revised allowable radiation and contamination limits. Survey activities included detailed radiological surveys, decontamination of all areas identified as having residual radiation activity, and a post-decontamination survey **(HRA-3007 Encl 1, p 11)**. Building-specific findings and activities are discussed below.

6.4.9.1 Building 364

Decontamination of Building 364 was achieved by the "survey-clean-survey" method. Areas of known or suspected contamination were surveyed by direct reading over a 1-by-1-foot grid system, with fixed readings at each corner and at the center of each grid. Swipe samples on a 1-meter square grid were collected. Decontamination was accomplished by paint removal and concrete chipping. Decontaminated areas were then resurveyed to verify that the decontamination was effective **(HRA-3007 Encl 2)**.

6.4.9.2 Building 815

The detailed radiological survey of Building 815 focused on areas found to be contaminated during the July 1978 RASO survey. The areas of concern included Room 1109 on the first floor; Rooms 218, 222, 255, and 2153 on the second floor; radioactive sources on the fourth floor; the Biological and Medical Sciences Division on the fifth floor; and the entire sixth floor **(HRA-3007 Encl 1)**.

The survey included surface beta and alpha scans using a grid system on floors, walls, bench tops, and fume hood interiors. Areas with higher than average readings within the grid, the fume hood, and exhaust ducts were also swipe sampled for H-3 and carbon-14 (C-14) contamination.

Decontamination procedures at Building 815 included the following **(HRA-3007 Encl 1, p 10)**:

- Removing flooring, contaminated ceramic sinks, and contaminated surfaces
- Removing paint
- Chipping concrete
- Cleaning with detergent all cabinet, light fixture, and crane rail top surfaces in Room 1109 and contaminated fume hood interiors
- Vacuuming accumulated dust from duct interiors
- Power sanding or manual scraping using a carbide-tipped scraper on metal surfaces, and removing contaminated floor blocks in the machine shop (Room 407) by sawing
- Removing plumbing parts, including contaminated valves and valve handles

6.4.9.3 Building 816

Building 816 surveys indicated no measurable contamination using the same instruments used during the 1978 RASO survey; however, this building had a history of H-3 use, and the instruments used in 1978 were not capable of measuring H-3 **(HRA-3007 Encl 2, p 1)**. Therefore, the building was resurveyed using appropriate instruments in October 1979. Swipe samples were collected from five locations throughout the building. On average, one swipe sample was collected for every 50 square feet of floor and wall space. Swipe samples were collected from the target pit, target room, magnet room, laboratory, and accelerator room. RASO analyzed the swipe samples for low-energy beta radioactivity **(HRA-2998 App A; HRA-3007)**.

Survey results of those areas indicated that surface radiation levels for fixed and removable contamination met *AEC Regulatory Guide 1.86* guidelines **(HRA-3007 Encl 2, p 6)**.

Final results of the decontamination effort and resultant survey were submitted to NRC, who agreed that the buildings met NRC guidelines for unrestricted use **(HRA-1040)**.

6.4.10 1986 EPA NNPP Operation Investigation

In 1984, the NAVSEA requested that EPA conduct harbor surveys at all active facilities servicing nuclear-powered warships. These surveys were to assess levels of environmental radioactivity resulting from the maintenance and operation of nuclear-powered warships and to evaluate whether these activities posed significant exposure risks to potential human receptors or resulted in significant environmental contamination. In September 1986, EPA collected bottom sediment, water, and biological specimens near the drydocks and pier areas at HPS, including Drydocks 2, 3, and 4 and Berths 2 and 17, where nuclear-powered warships had been berthed or serviced **(HRA-2951)**.

The study focused on Co-60 because it was the predominant radionuclide associated with NNPP operations. However, the gamma spectroscopy performed would have also identified other gamma-emitting radionuclides if they were present. Water samples were also analyzed for H-3.

This investigation included both field gamma radiation surveys and sample analyses. An underwater gamma survey was conducted using a sodium iodide (NaI) scintillation detector to locate any areas of elevated radioactivity. Sediment samples were collected from the detector measurement locations. One core sample was collected from the Drydock 4 area to determine the vertical distribution of radioactivity in harbor bottom sediment, and surface water samples were also collected near this drydock. Vegetation (sea lettuce) and mussel samples were collected from the Bay.

The underwater gamma scintillation probe did not detect any areas on the harbor floor where radioactivity levels exceeded background levels. Only naturally occurring nuclides and trace quantities of Cs-137, at levels typically associated with fallout from previous worldwide nuclear weapons testing, were detected in the sediment samples. Surface water samples contained no H-3 exceeding the MDA of 200 picocuries per liter (pCi/L). Potassium 40 (K-40), a naturally occurring radionuclide, was the only gamma-emitting radionuclide detected. Biological samples of sea lettuce and mussels all contained small quantities of naturally occurring radionuclides. The gamma exposure rates averaged 4.4 ± 0.4 microrems per hour (μrem/hr), which is comparable to measured background levels of 4.1 ± 0.2 μrem/hr **(HRA-2951, pp 13-14)**.

This radiological survey concluded that only naturally occurring radionuclides and trace amounts of Cs-137 from fallout were detected at HPS. Based on this survey, EPA concluded that operations related to nuclear-powered warship activities contributed no detectable radioactivity to Drydocks 2, 3, or 4 or Berths 2 and 17 **(HRA-2951, p 15)**.

6.4.11 1988-1989 HLA Site Reconnaissance

In 1988, HLA conducted a preliminary surface radiation survey to determine if radioactivity levels at HPS posed unacceptable exposure risks to RI field workers. Project activities included a scintillation survey for radiation at surface locations at the Industrial Landfill (IR-01/21), the Bay Fill Area (IR-02), and the Submarine Base Area (Sub-Base Area) (IR-07). Radioactivity was also measured at other HPS and Bay area locations to determine background levels. Survey results were compared with established background levels to determine whether G-RAM sources were present in or near the surface. Survey results indicated gamma readings exceeding background levels, and additional investigation of these anomalies was recommended **(HRA-2958, pp 17-19)**.

Gamma counts were measured at predetermined on- and off-site locations to obtain background data and at the nodal points of a 50- by 50-foot grid. Gamma scintillation counts were measured at ground surface and at 1 meter above ground surface at each grid node and along grid lines.

The Industrial Landfill surface gamma survey was conducted at grid points over the entire landfill. The average gamma count rate was determined to be significantly below the mean of the background values measured at HPS. Surface gamma counts at one location in the landfill exceeded the average level at the landfill but were close to the mean of the HPS background values. A pile of shale and serpentinite gravel in the northwest corner of the landfill also exhibited elevated gamma readings, but they were below the mean of the background gamma levels. These elevated readings were attributed to natural radiation within the shale and serpentinite bedrock gravel **(HRA-2958, p 50)**.

An area of five anomalous gamma readings in the Bay Fill Area (IR-02) was surveyed in more detail using a 10-by-10-foot grid spacing, as well as a ground scanning method. Twenty-four elevated readings were detected using the 10-by-10-foot grid spacing, and 8 more were identified using the ground scanning method. Anomalies detected between grid nodes were recorded, mapped, and included in a database. The Bay Fill Area surface gamma survey also indicated some small, discrete areas in IR-02 Northwest, where gamma counts exceeded background but did not exceed the reporting limits of that time **(HRA-2958, p 41)**.

The Sub-Base Area gamma survey showed that levels detected were within the natural background for HPS and the Bay Area.

6.4.12 1991 to 2001 Remedial Investigation Surveys

In 1991, the Navy began radiation investigations at HPS in four main phases as part of the RI program. Activities conducted under each phase are briefly summarized below.

- Phase I consisted of a surface confirmation radiation survey (SCRS) that included air, soil, and groundwater sampling **(HRA-593)**.
- Phase II focused on the subsurface distribution of radioactive point sources detected in the top 1 foot of soil during Phase I **(HRA-2993)**.
- Phase III focused on radiological issues related to (1) NRDL operations at HPS, (2) the licensing of G-RAM use by the NRC in support of NRDL activities, and (3) preliminary findings for buildings and sites used by NRDL in Parcel B **(HRA-2997)**.
- Phase IV was performed to quantify ambient concentrations of specific radionuclides and to further characterize contamination sites outside Buildings 364 and 707 **(HRA-3011)**.

Each of the four phases and related interim investigations is summarized below.

6.4.12.1 Phase I Radiological Investigation

The Phase I radiological investigation was conducted in two stages: (1) air monitoring and (2) the SCRS. Phase I particulate air monitoring was conducted from August through September 1991 to determine the background airborne particulate alpha and beta radioactivity levels in and around IR-01, IR-02, and IR-05. Groundwater samples were also analyzed for gross alpha and gross beta radioactivity to determine whether the presence of radium-bearing devices in soil was impacting groundwater **(HRA-593)**.

The Phase I SCRS was initiated in 1992 to determine and confirm the nature and surficial extent of radium-bearing devices in the disposal area at the Bay Fill Area (IR-02 Northwest).

The Phase I SCRS included the Industrial Landfill (IR-01/21), the Bay Fill Area (IR-02), IR-03, the Sub-Base Area (IR-07), IR-14, IR-15, the Waste Oil Disposal Area (IR-18), and IR-19. Field activities included a walkover surface gamma survey, soil sampling and analysis, radon flux testing, groundwater well sampling, and down-hole gamma radiological surveys inside the casings of groundwater monitoring wells. In addition, cursory surveys were conducted at the following former NRDL sites: Buildings 364 (referred to as Building 351A in PRC Environmental Management, Inc. [PRC] 1992 report), 701, and 816 and Drydock 4 **(HRA-2984)**.

The investigation techniques and findings are discussed below.

6.4.12.1.1 Investigation Techniques

A grid coordinate system was developed to map and locate G-RAM detected during the 1988 surface walkover survey. Each grid square measured 300 by 300 feet and was further subdivided into 30-by-30-foot sub-grids. Health physics technicians performed the surface gamma walkover survey using 2-by-2-inch NaI detectors coupled to rate meters to detect gamma-emitting radioactive material within the Landfill Area. During the Phase I radiological investigation, gamma readings exceeding two times the background level were considered potential G-RAM anomalies associated with buried radium-containing devices. Background levels were determined on a sub-grid-specific basis **(HRA-2984)**.

When elevated gamma readings were observed, the location, gamma measurement, and exposure measurement were recorded, and a biased soil sample was collected to identify radionuclides. To provide additional characterization information, soil samples were also collected at random unbiased locations throughout the Parcel E area at a frequency of one sample per 2 acres. All soil samples were analyzed at an off-site laboratory using gamma spectroscopy to identify and quantify gamma-emitting radionuclides.

Radon flux canisters were placed on ground surfaces at selected locations at and around areas of anomalous readings to attempt to detect radon gas, a radioactive gas emitted by the decay of Ra-226. Increased radon concentrations might indicate the presence of subsurface radium-containing devices. Radon released during the Ra-226 decay process would be captured by adsorption to carbon in the flux canister. Canisters were removed after a 24-hour exposure period and analyzed at an off-site laboratory using gamma spectroscopy.

Seven groundwater samples were collected and tested for alpha, beta, and gamma radioactivity. Gamma spectroscopy was used to identify gamma-emitting radionuclides. Six wells in IR-02 and one well in IR-07 were tested. A down-hole gamma radiation survey was performed inside the casing of the same wells from which the groundwater samples were collected. A NaI scintillation detector was lowered to the water level, and the gamma count rates were recorded at 1-foot intervals.

In addition, Buildings 351A, 701 (in ruins), 816, and Drydock 4 were surveyed using both NaI scintillation and Geiger-Mueller detectors **(HRA-2984)**.

6.4.12.1.2 Findings

The gross alpha and gross beta airborne particulate concentrations were well within safety standards for airborne concentrations of G-RAM in ambient air **(HRA-2984)**.

During the surface walkover survey, nine radioactive point source anomalies associated with radium-containing devices were observed in the southwestern and northeastern portion of IR-01/21. Over 300 radium-containing point sources (such as instrument dials, glass beads, and gauges) were observed in a centralized area at IR-02 Northwest that extended about 50 feet across the site boundary into IR-02 Central. This area corresponds to one of the HPS industrial waste disposal areas. The anomalous area measured about 600 by 600 feet and was centered about 500 feet west of Building 600. Radium-containing devices were observed on the ground surface at IR-02 Northwest and were removed prior to soil sample collection. A few elevated gamma readings were observed in the inter-tidal area at IR-02 Northwest. One G-RAM point source anomaly was observed at IR-02 Central, east of the Building 600 parking lot. A few elevated gamma readings were observed at scattered locations at IR-02 Southeast, but no radium-containing devices were identified at these locations. At IR-07 and IR-18, areas with anomalous readings were observed in light brown sand exposed on the slopes at the Donahue Street boundary. Gamma activities exceeding the site background value by more than 50 percent and general area gamma activities were noted. No anomalies were detected at the shoreline.

Areas containing sandblast waste were scattered throughout the IR-14 area. G-RAM point source anomalies were not found at IR-03, IR-14, IR-15, or IR-19, but a combination safe at IR-14 had elevated gamma activity associated with a dial and handle on its door. The safe was moved to a low-level radioactive waste (LLRW) container within Building 414. The safe was moved to Building 130 in 1995 prior to off-site disposal. Phase I SCRS results resulted in a recommendation for further investigation.

Soil samples contained Ra-226, its daughter products, and other naturally occurring radionuclides. Except for Ra-226 and its daughters, no concentrations exceeded background levels. A few samples from IR-01/21 and IR-02 Central and many samples from the disposal area at IR-02 Northwest contained radium-bearing devices that were removed before laboratory analysis of the associated soil. These radium-bearing devices were placed in properly labeled drums and stored in the LLRW structure within Building 414 and then moved to Building 130 prior to off-site disposal.

Elevated levels of radon gas were observed mainly at IR-02, where radon flux canisters were placed directly on top of radium-bearing devices at the ground surface. Flux canisters placed at locations where radium-bearing devices were not visible did not detect radon gas above background levels. Gross alpha and beta levels were not elevated in the air samples collected from and around Parcel E.

Groundwater samples were collected at three wells in IR-02 Northwest, one well in IR-02 Central, two wells in IR-02 Southeast, and one well at IR-07. However, because dissolved and suspended solids in the groundwater samples interfered with analysis, the results were inconclusive in determining the presence of radioactivity. Six of the seven monitoring wells that underwent the down-hole gamma radiation survey exhibited elevated count rates that were considered indicative of bentonite seals in the borehole annulus around the well casings **(HRA-2984)**.

Building and structure specific survey results from a hand-held scanning instrument are summarized below **(HRA-2984)**.

- **Building 351A –** Elevated alpha and gamma activity was measured at one of the trenches. Additional investigation of the sump area was recommended.
- **Building 701 –** No radiation anomalies were detected.
- **Building 816 –** Alpha, beta, and gamma activities levels were comparable to background levels.
- **Drydock 4 –** No radiation anomalies were detected.

6.4.12.2 Phase II Radiological Investigation

The Phase II radiological investigation was conducted at Parcels B and E from 21 January through 25 July 1993, in an attempt to delineate the subsurface distribution of radium-containing devices at the IR-01, IR-02, IR-07, and IR-18 fill areas **(HRA-2993)**.

The investigation techniques and findings are summarized below.

6.4.12.2.1 Investigation Techniques

To delineate the subsurface distribution of G-RAM point sources in the fill areas, 27 15-foot-deep test pits and three 100-foot-long trenches were excavated at IR-02 Northwest. One of these trenches extended about 40 feet across the site boundary into IR-02 Central.

Seven 15-foot-long test pits were excavated at IR-02 Central along the IR-02 Northwest site boundary. Six 15-foot-long test pits were excavated at IR-01/21. The excavation locations were chosen to:

- Include known and potential areas of elevated radiation based on Phase I radiological investigation results and historical information,
- Provide detailed soil stratigraphy data, and
- Identify the types and depths of buried debris associated with radiation anomalies.

The trenches and test pits were excavated until either Bay mud or groundwater was encountered or until the walls of the excavation became unstable. Trench and test pit depths ranged from 2.5 to 10.5 feet bgs, with an average depth of about 8 feet bgs. Buried radium-bearing devices found in subsurface soils were removed, placed in properly labeled drums, and stored in the LLRW storage area in Building 414. The drums were later moved to Building 130 prior to off-site disposal. A trench pit was excavated in both IR-07 and IR-18. The two pits contained silty sand approximately 1-foot thick at the surface. Sandstone bedrock was encountered at 2.5 feet bgs in IR-07. Weathered serpentinite bedrock was encountered at IR-18 **(HRA-2993)**.

Using 2-by-2-inch NaI detectors, health physics technicians scanned the walls of each excavation at 2-foot intervals. When elevated gamma readings were observed, the locations, gamma measurements, and exposure measurements were recorded. Gamma count rates exceeding 1.5 times the background level were considered G-RAM point source anomalies associated with buried radium-containing devices. G-RAM source locations were further investigated by excavation. If radium-bearing devices were found, the device(s) and soil samples were collected. The samples were analyzed at an off-site laboratory using gamma spectroscopy to identify and quantify gamma-emitting radionuclides **(HRA-2993)**.

Down-hole gamma logging was performed at 22 groundwater monitoring wells using a gamma detector. Five soil cores were collected to measure the air permeability of the soil to evaluate radon gas flux rate measurements obtained during the Phase I radiological investigation. Four cores were collected from IR-02 and one from IR-07.

High, medium, and low volume air sampling was performed during excavation activities to determine the concentrations of airborne radioactive particulates **(HRA-2993)**.

6.4.12.2.2 Findings

One well surveyed during the down-hole gamma logging showed gamma activity. This was considered indicative of a bentonite seal as in Phase I. The air permeability testing during the Phase I investigation was not considered a good indicator of radon flux measurements. Therefore, this test was deemed not useful in detecting buried Ra-226 sources. Gross airborne alpha and beta particulate activity did not exceed 10 percent of standards in Title 10 of the CFR, Part 20. Site-specific findings are summarized below **(HRA-2993)**.

- **IR-01 –** No elevated gamma count rates were measured in the test pits or trenches.
- **IR-02 –** Of the 34 test pits and 3 trenches excavated, 12 test pits and 2 trenches contained a total of 111 gamma-emitting anomalies. A total of 96 point sources indicating radium-containing devices were found between the ground surface and 6.5 feet bgs in these areas. Ra-226, lead 214 (Pb-214), bismuth-214, and Ra-226 daughters were detected at the site.
- **IR-02 –** Four excavations exhibited a gamma count rate distribution that differed from the other excavations. A large proportion of the elevated gamma count rates were correlated with the presence of firebrick.
- **IR-02 –** Two test pits contained crushed or decomposed radium-bearing devices with a small volume of contaminated soil around them.
- **IR-07 and IR-18 –** No point sources of elevated gamma activity were detected in the test pits.

6.4.12.3 Phase II to Phase III Interim Investigations

The seven interim investigations discussed below were conducted between the Phase II and Phase III radiological investigations.

6.4.12.3.1 1993 PRC H-3 Study

In May 1993, the Navy sampled surface soils and paving materials around Building 816 for H-3. Previous survey and release data during NRDL disestablishment and subsequent NRC verification were obtained from inside the building only. CDHS expressed concern that NRDL personnel may have tracked H-3-contaminated wastewater from inside the building to exterior soils and pavement and recommended further surveys outside. Sampling locations were selected based on site visits and discussions with a former NRDL employee and RASO representatives.

Surface soil samples were collected approximately 6 inches from walkways and from the building foundation. This selection was based on the assumption that water runoff would flow into soil immediately downgradient and adjacent to a walkway or paved area. Concrete and asphalt samples were collected from beside the building foundation out to 2 feet from the building, based on an assumed walking path. The pavement was broken so soil below the paving material was sampled. Concrete and asphalt samples were collected using a pneumatic chisel.

Survey results confirmed that all the H-3 results were below the MDA of 0.5 picocuries per gram (pCi/g). CDHS conducted an independent outdoor survey and confirmed the Navy's findings (see below) **(HRA-2998)**.

6.4.12.3.2 1993 CDHS H-3 Study

CDHS conducted an independent confirmatory soil sampling for H-3 to verify the results of the Navy's study at Building 816. Four soil samples were collected around the building and sent to the CDHS Sanitary and Radiation Laboratory for H-3 analysis. The results showed that H-3 concentrations were all below the detection limit of 2.35 pCi/g; these results confirmed that H-3 activity was within background levels. EPA concurred that no further actions were required **(HRA-2945)**.

6.4.12.3.3 1993 EPA Study of Parcel E Soil

EPA's National Air and Radiation Environmental Laboratory (NAREL) analyzed 13 soil samples from Parcel E (IR-02) to determine particle size, radionuclide distribution, and radionuclide content. Three of the samples contained elevated levels of Ra-226. The remainder contained Ra-226 at concentrations comparable with background. Depending on the soil sample collected, different distributors of Ra-226 were found. Ra-226 was sometimes found to be approximately equal between particle-size fractions, sometimes preferring the smaller fractions, and therefore indicating contamination by oxidation or fragmentation.

The study concluded that, based on the background concentrations detected in 10 of the 13 samples, a significant volume of Parcel E soil may contain background levels of Ra-226. The report also concluded that, based on the soil particle-size distribution in Parcel E, particle-size separation could be accomplished by hydro-classification or sieving with equipment typically used by the mineral processing industry to remove radium sources. The evaluation of elevated soil radioactivity indicates that sources had apparently released radium into immediately adjacent soil. Therefore, removal of the radium sources should also be accompanied by removal of contaminated soil in the immediate vicinity of the radium sources **(HRA-2954)**.

6.4.12.3.4 1994 EPA Petrographic Study of Parcel B

EPA's NAREL conducted this study to evaluate the use of a soil sieving treatment technology for removing radium from soil around the buried radioluminescent devices in Parcel B **(HRA-2953)**. A previous study determined that part of HPS could potentially be remediated through removal of soil, identifying Ra-226 sources, and removing the sources from soil by particle-size separation **(HRA-2954)**.

NAREL collected three soil samples from IR-07 and IR-18 for petrographic and radiological analysis. The soil's mineralogy (particle size, mineral type, and other physical characteristics) was established using petrographic analysis. Its radioisotopic constituents were identified by gamma spectroscopic analysis. This information was used to determine whether the soil composition was natural or contained remnants of radioactive material from past Navy operations.

EPA's petrographic analysis concluded that Parcel B soils contain naturally occurring radioactive isotopes of the uranium and thorium decay series. These radioactive materials, including Ra-226, are naturally present in the granitic minerals, monazite and zircon. The report further concluded that the radioactive material content of Parcel B soil had not been depleted or enhanced by any manufacturing process. The study stated that the soil had been imported from another location in California for use as fill at HPS and would not be amenable to the originally proposed treatment technology **(HRA-2953)**.

CDHS concurred with EPA's technical findings and recommended the release of IR-07 and IR-18 in 1995 **(HRA-2946)**.

6.4.12.3.5 1994 Drydock 4 Surveys (MINS and PRC)

An earlier radiological investigation performed by MINS personnel identified a possible Ra-226 point source at Drydock 4. MINS personnel did not remove the point source because it did not contain Co-60, the radionuclide of concern for the survey **(HRA-2951)**. Subsequently, MINS conducted another survey on 21 July 1994, and removed the Ra-226 point source **(HRA-2960)**. In September 1994, PRC conducted a radiological survey at the drydock to confirm that no radioactivity exceeding background levels remained **(HRA-2987, p 1)**. The radiological survey consisted of a 100-percent walkover gamma survey of the drydock floor area using a NaI detector, a gamma detector, and an exposure rate survey instrument. Sediment samples were also collected at each location where an anomalous gamma count rate was observed for gamma spectroscopic analysis.

This survey confirmed that no G-RAM remained at the drydock exceeding background levels. The Navy leased Drydock 4 to a civilian business in September 1994 **(HRA-2960; HRA-2987)**.

6.4.12.3.6 1996 ATG Building 364 Peanut Spill Remediation

Allied Technology Group, Inc. (ATG) performed an interim removal action at the Cs-137 spill area behind Building 364 (also known as the "peanut spill") in 1996 **(HRA-2941)**. This contaminated area of asphalt was discovered in 1993 during the Parcel D RI **(HRA-2994; HRA-2995, pp 11-13)**. Initial site radiological surveys consisted of screening with scintillation and Geiger-Mueller detectors, collecting swipe samples, and sampling soil prior to the removal action. ATG excavated the peanut-shaped area to approximately 4 inches bgs and removed a total of 30 cubic feet of soil. The area was then resurveyed, and 20 confirmatory soil samples were collected for Cs-137 analysis. Sample results ranged from 0 to 1.2 pCi/g of Cs-137, with an average of 0.34 pCi/g. These levels were within the NRC Technical Report Nuclear Regulatory Guide (NUREG)-1500 limit of 2.14 pCi/g, at the 3 mrem per year level for residential areas, which was the release limit of the period **(HRA-2941)**.

6.4.12.3.7 IDW Investigation

As a result of RI activities that were conducted at IR-01/21, IR-02, IR-03, IR-07, and IR-18, investigation-derived waste (IDW) containers were identified as potentially containing radioactive material. Preliminary radiological surveys of the drums and bins were generally conducted prior to off-site disposal. These containers were initially stored in controlled areas within Building 810. The drums were later transferred to Building 414, and then again to Building 130 for storage prior to disposal **(HRA-2990)**. The typical screening process consisted of weighing each drum, measuring the gamma exposure rate using a 2-by-2-inch NaI detector, and collecting samples from approximately 250 drums for laboratory analysis **(HRA-2986)**.

In December 1994, PRC recommended reducing the volume of IDW to be screened by limiting the amount of IDW to be generated at IR-02, IR-07, and IR-18 based on existing survey and sample results. Drums that did not require a radiological survey were disposed of using normal procedures **(HRA-2990; HRA-2988)**.

In 1997, New World Technology (NWT) performed a disposal action on all remaining bins and containers housed in Building 130 that had exceeded the previously established count rate. A radium-bearing dial from a safe was also disposed of. Other than those drums known to contain sources retrieved during the Phase I and II radiological investigations, no other drums were identified as containing radioactive materials **(HRA-2983)**.

6.4.12.4 Phase III Radiological Investigation

The PRC Phase III radiological investigation was conducted from 1996 to 1997. It was intended to address concerns regarding the use, storage, and disposal of radioactive material during past NRDL operations at HPS. The goal of this phase was the eventual release of all remaining buildings and sites in Parcels D and E for unrestricted use. The effort included Buildings 351A, 506 through 510, 510A, 517, and 529; the Building 364 Cs-137 peanut spill area; and the Building 707 concrete pad area.

Phase III radiological investigation techniques and findings are discussed below.

6.4.12.4.1 Investigation Techniques

Phase III investigations consisted of surface gamma walkover surveys and collection of soil, asphalt, concrete, and swipe samples **(HRA-2994)**. Ten-by-10-foot square grids were established to map and identify anomalies detected during the surveys. A global positioning system was used for reference. The walkover survey was performed using a NaI detector. Additionally, a static (fixed location for a specified period of time) gamma survey was performed. When elevated gamma readings were observed, the location, count rate, and exposure rate measurements were recorded. Soil samples were collected at those locations to determine which gamma-emitting radionuclides were present above background levels. Swipe samples were collected from the surface of the Building 707 concrete pad. All samples were analyzed by gamma spectroscopy at an off-site laboratory to determine the amount and identification of radionuclides that might be present.

6.4.12.4.2 Findings

Phase III radiation investigation report recommendations are summarized below (HRA-3009).

- Building 351A may be considered for release by the Navy for unrestricted public use.
- Additional investigation must be performed at the wall of the sump and the utility trench wall at the Building 364 sump site.
- No recommendation was presented for Building 506.
- The area around the anomalous count rates at Buildings 509 and 517 should be assessed for a potential removal action.
- The potential buried point source behind Building 529 should be excavated and removed.
- Additional investigation at Building 707 and the concrete pad is needed to determine the nature and extent of the elevated Ra-226, thorium-228 (Th-228), and Th-232 concentrations and to determine whether removal is necessary.
- Buildings 507, 508, 510, and 510A can be released for unrestricted public use.

6.4.12.5 Interim Parcel E Radiation Risk Assessment

As part of the Parcel E draft final RI, PRC performed a radiation risk assessment to evaluate potential risks associated with human exposure to radionuclides detected at Parcel E. The risk assessment was presented as Appendix P of the Parcel E RI report (HRA-3009, pp P-1 to P-63).

The risk assessment evaluated exposures and risks to human health under future residential and industrial land-use scenarios for five sites in Parcel E: IR-01/21, IR-02 Central, IR-02 Northwest, IR-02 Southeast, and IR-11/14/15. Ra-226 and its radioactive daughters (lead-210 [Pb-210] and radon-222 [Rn-222]) were identified as radionuclides of potential concern. The sources of these radionuclides are radium-containing devices from ship repair and maintenance activities that were disposed of in IR-02 Northwest and Central. Data collected as part of the Phase I through Phase III radiological investigations were used to conduct the risk assessment.

For purposes of the risk assessment, Parcel E was divided into 0.5-acre and 2,500-square-foot exposure areas to represent industrial and residential land use, respectively. A total of 147 residential and 35 industrial areas were evaluated in the risk assessment. For each residential and industrial exposure area, an exposure point concentration was calculated based on the number of anomalies observed during the Phase I through Phase III radiation investigations.

Under the residential land-use scenario, residents were assumed to be exposed to radionuclides through ingestion of soil, inhalation of airborne particles, ingestion of homegrown produce, inhalation of Rn-222 gas, and external exposure. Under the industrial land-use scenario, workers were assumed to be exposed to radionuclides through ingestion of soil, inhalation of airborne particles, inhalation of Rn-222 gas, and external exposure.

Information from data evaluation, exposure assessment, and toxicity assessment were compiled and used in the DOE computer modeling program "RESRAD." RESRAD models a time-dependent source term that accounts for radioactive decay and leaching and erosion in the contaminated zone and considers site-specific geologic and hydrogeologic parameters. RESRAD was used to estimate the excess lifetime cancer risk (ELCR) that would result from exposure to Ra-226 and its decay products for residents and workers at Parcel E. EPA has established an "acceptable" risk range for carcinogenic risk from exposure at a Superfund site of 1×10^{-6} to 1×10^{-4}. In general, a potential ELCR of 1×10^{-6} is used by EPA as a point of departure for determining remediation goals.

Risks were quantified for exposure to Ra-226 in soil and to its resulting daughter product Rn-222 in indoor air. Because the Rn-222 risk is relevant only if buildings are constructed in the contaminated areas, this risk was assessed separately **(HRA-3009)**.

For exposure to Ra-226, all of the 147 residential exposure areas had total ELCRs greater than 1×10^{-6} and less than 1×10^{-4} for the reasonable maximum exposure (RME) scenario. For the average exposure scenario, 51 residential exposure areas had total ELCRs greater than

1×10^{-6}, and no residential exposure areas had total ELCRs greater than 1×10^{-5}. Of the 35 industrial exposure areas, nine had ELCRs between 1×10^{-6} and 1×10^{-5} for the RME case, and 26 industrial exposure areas had ELCRs below 1×10^{-6}. For the average exposure scenario, all industrial exposure areas had ELCRs below 1×10^{-6}. External exposure to radiation was determined to be the dominant exposure pathway for both the residential and industrial exposure scenarios **(HRA-3009, p 59)**.

For exposure to Rn-222 gas in indoor air, 21 of the 147 residential exposure areas had ELCRs greater than 1×10^{-4}, and the remaining 126 exposure areas had ELCRs between 1×10^{-6} and 1×10^{-4} for the RME scenario. For the average exposure scenario, 88 residential exposure areas had ELCRs between 1×10^{-4} and 1×10^{-6}, and 59 exposure areas had ELCRs below 1×10^{-6}. Of the 35 industrial exposure areas, 16 exposure areas had ELCRs between 1×10^{-6} and 1×10^{-4}, and 19 exposure areas had ELCRs below 1×10^{-6} for the RME scenario. For the average exposure scenario, two industrial exposure areas had ELCRs between 1×10^{-6} and 1×10^{-5}, and 33 industrial exposure areas had ELCRs below 1×10^{-6}. Inhalation of Rn-222 gas is the only exposure pathway for both the residential and industrial exposure scenarios **(HRA-3009, p 61)**. Risks associated with Rn-222 gas are only relevant if buildings are constructed in the contaminated zone.

Most of the contaminated areas evaluated in this risk assessment lie along the shoreline and are slated for use as open space in San Francisco's reuse plan. The most likely receptor along the shoreline would be a recreational visitor rather than a resident or industrial worker. Receptors would not likely be exposed to the contaminated areas for 350 days per year (as assumed for residential exposure) or 250 days per year (as assumed for industrial exposure). Therefore, actual human exposure to radium in soil and radon gas in enclosed spaces and resulting health risks would be less than assumed in the radiation risk assessment, and are not considered significant. In addition, sources of Ra-226 are being further characterized as part of the Phase V radiological investigation, and the Navy will undertake actions to remove Ra-226 sources at Parcel E.

6.4.12.6 Phase IV Radiological Investigation

The Phase IV radiological investigation was begun in December 1998 to determine background concentrations of specific radionuclides and to further characterize areas of anomalous count rates that had been identified outside Buildings 364 and 707 during Phase III. Phase IV radiological investigation techniques and findings are summarized below **(HRA-2993; HRA-3012)**.

6.4.12.6.1 Investigation Techniques

A total of 32 samples (16 concrete and asphalt and 16 soil samples) were collected behind Building 364. Of the 32 samples, 16 were considered background samples. Thirty-eight concrete and 38 soil samples were collected at the Building 707 concrete pad area. All samples were analyzed using gamma spectroscopy **(HRA-3011)**.

6.4.12.6.2 Findings

Phase IV radiological investigation findings are summarized below.

- Samples collected from the Building 364 spill site and the Building 707 concrete pad contained concentrations of radionuclides distinguishable from background or that exceeded the revised site release criteria for Cs-137 of 0.13 pCi/g. The ATG removal action in 1996, with a release criterion of 2.4 pCi/g, had not removed sufficient material at Building 364 to meet current site-specific criteria **(HRA-3011)**.
- The radionuclides of concern included Am-241, Co-60, europium-152 (Eu-152), europium-154 (Eu-154), K-40, Ra-226, Th-228, Th-232, and U-235, and Cs-137. Cs-137 was the only radionuclide of concern to exceed site-specific background criteria at the Building 707 concrete pad.

A CERCLA removal action was recommended at both the Building 364 spill site and the Building 707 concrete pad to reduce residual radioactive materials at these sites to levels consistent with a recommended preliminary remediation goal (PRG) of 0.13 pCi/g for Cs-137 **(HRA-3011)**.

6.4.12.7 Interim Investigations between Phase IV and Phase V

Three interim investigations were conducted after the Phase IV radiological investigation. Available information for each investigation is summarized below.

6.4.12.7.1 1999 October IT Corporation Investigation

Sandblast waste was discovered and removed from an excavation site at IR-07. Five samples were collected and analyzed for radioactivity. Results were indicative of background concentrations **(HRA-3004)**.

6.4.12.7.2 2001 Tetra Tech EM Inc. Investigation

In June and July 2001, Tetra Tech EM Inc. contracted a survey of the Gun Mole Pier (Regunning Pier) **(HRA-3014)**. Gamma and beta measurements were obtained on the pier to determine whether elevated radioactivity levels remained from previous operations. The measurement points were based on a newly found drawing, indicating the previous location of the concrete test pad and NRDL barge on the pier **(HRA-4719)**. Gamma levels were measured using a portable detection instrument equipped with a NaI scintillation probe. The measurements were made both in a systematic grid pattern and specifically over drains, surface cracks, and other unusual features.

Surface radioactivity at selected locations was also measured using a Geiger-Mueller detector sensitive to beta radiations.

Findings indicated that only background levels of radioactivity were present in the areas surveyed.

6.4.12.7.3 NWT Interim Investigation and Removal Action

During 2001, NWT performed a removal action at the tank vault behind Building 364. Others had removed the tanks, piping, and support equipment previously, and the remaining vault surfaces had been identified as exceeding site release criteria. The concrete vault was broken and removed using standard industrial demolition equipment, packaged, and shipped for disposal to a licensed disposal facility. Surveys and soil sampling performed following removal of the concrete vault indicated that no residual contamination remained that exceeded site release criteria. The excavation was backfilled.

Additionally, a characterization survey of the Parcel E shoreline was performed. Gamma scans were conducted over pre-positioned grids using 2-by-2-inch NaI detectors and Ludlum Model 2360 Data Logger instruments. The shoreline survey encompassed areas within approximately 50 feet of the mean tide line with each grid assigned an individual identifier. The grid corners were identified using global positioning system coordinates. Several areas were noted during the survey that exceeded background gamma radiation levels, most significantly the area known as the "metal reef." Samples obtained from those locations identified Ra-226 as the contaminant. The elevated reading locations were noted on survey maps. No removal actions were taken at the time of the survey.

6.4.12.8 Phase V Investigations

Beginning in January 2002, NWT conducted scoping and characterization surveys, soil and other media sampling programs, remediations, and final status surveys at various areas and in various buildings at HPS in accordance with MARSSIM guidelines **(HRA-2937)**. The investigations and surveys were in support of the release of buildings or areas that had been identified as areas where radioactive materials had been used or areas where remedial actions to remove known contamination had occurred.

The Phase V Investigations were conducted within a standard protocol that allowed for application of MARSSIM guidelines in the survey process. Each site was assessed for potential radionuclides of concern with surveys designed according to the MARSSIM area classification (Class 1, 2, or 3). In general, the surveys included gamma scans, gamma static readings, alpha/beta static readings, dose rate measurements, alpha/beta swipes, H-3 swipes (if appropriate), and sample analysis (alpha or gamma spectroscopy or beta analysis, as appropriate). The extent of the surveys depended upon the classification of the area. Class 1 surveys covered 100 percent of the area, Class 2 surveys covered 50 percent of the area, and Class 3 surveys covered 20 percent of the area. Static measurements were distributed accordingly.

If contamination was found in a Class 3 area, a 100 percent characterization survey was conducted followed by remediation as appropriate. A Class 1 Final Status Survey followed these actions. A synopsis of the results of the Phase V Investigation is provided in Table 6-6. Site-specific information for the Phase V Investigation is provided in Table 6-7. Site-specific information is provided in Section 8.0.

SECTION 6
TABLES

TABLE 6-1
SITES IMPACTED BY G-RAM USE BY THE SHIPYARD

Site	Purpose/Use
Building 113A	Gamma Radiography
Building 146	Gamma Radiography and Source Storage, Turn-In of Radium Devices, and Radioactive Waste Storage
Building 157	Radiography
Building 211	Welding Shop
Building 214	Gamma Radiography
Building 241	Shipyard Foundry
Building 253	Gamma Radiography, RADIAC Calibration, Radium Device Maintenance, and Possible Location of Radium Paint Shop
Building 271	Possible Radium Paint Shop
Building 272	Possible Radiography Shop
Building 351A	RADIAC Calibration, Radiography Shop, and Instrument Repair Facility
Building 366	Radium Device Maintenance and Boat/Plastics Shop
Building 383 Area	Turn-In Site for Radioluminescent Devices Removed from Ships
Building 408	Smelter – Disposal of Equipment with Radium Devices
Building 411	Gamma Radiography
Building 807	Scrap Yard Processing Shed
Building 813	Warehouse and Storage and Disaster Control Center
Building 819	Sanitary System Pump Station
Drydock 2	Equipped with Radioluminescent Devices, Removal of Radioluminescent Devices from Ships, and YAG Decontamination
Drydock 3	Equipped with Radioluminescent Devices and Removal of Radioluminescent Devices from Ships
Drydock 4	Equipped with Radioluminescent Devices and Removal of Radioluminescent Devices from Ships
Drydock 5	Removal of Radioluminescent Devices from Ships
Drydock 6	Removal of Radioluminescent Devices from Ships

TABLE 6-1
SITES IMPACTED BY G-RAM USE BY THE SHIPYARD

Site	Purpose/Use
Drydock 7	Removal of Radioluminescent Devices from Ships
Gun Mole Pier	Removal and Turn-In of Radioluminescent Devices
Parcel E Shoreline	Disposal of Radioluminescent Devices Mixed in with Other Waste and Material from Smelter, Incinerator, Foundry, and Burn Pits
IR-01/21	Landfill – Disposal of Radioluminescent Devices, NRDL Waste, Sandblast Media and Material from Smelter, Incinerator, Foundry and Burn Pits
IR-02	Bay Fill Area – Disposal of Radioluminescent Devices, NRDL Waste, Sandblast Media, and Material from Smelter, Incinerator, Foundry, and Burn Pits
IR-03	Oil Reclamation Ponds – Disposal of Radioluminescent Devices
IR-04	Scrap Yard – Disposal of Equipment with Radioluminescent Devices
IR-07	Potential Disposal of Radioluminescent Devices
IR-18	Potential Disposal of Radioluminescent Devices
Salvage Yard	Disposal of Equipment with Radioluminescent Devices

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS ACHOMAWI ATF-148 FLEET OCEAN TUG	Support	01Sep46 PH	Own Power	SF Arrive 04Oct	06DecC46	13Dec46	Sold as scrap 22Mar86, Taiwan
USS AJAX AR-6 REPAIR SHIP	Support	28Aug46 PH	Own Power	SD	01Jan47	Unknown	Sold as scrap 23May97
USS ALBEMARLE AV-5 SEAPLANE TENDER	Support	30Jul46 PH	Own Power	LA	Unknown	22Nov46	Sold as scrap 17Jul75
USS ALLEN M. SUMNER DD-692 DESTROYER	Support	10Aug46 PH	Own Power	PS	19Nov46	10Jan47	Sold as scrap
USS ANDERSON DD-411 DESTROYER	Target	N/A	N/A	N/A	N/A	N/A	Sunk 01Jul46 Bikini Atoll by Able Shot
APL-27 NON-SELF PROPELLED BARRACKS SHIP	Support	01Jul47	Towed	KA	25Feb47	10Mar46	MARAD transfer scrapped 1960
USS APOGON SS-308 SUBMARINE	Target	N/A	N/A	N/A	N/A	N/A	Sunk 25Jul46 Bikini Atoll by Able Shot
USS APPALACHIAN AGC-1 AMPHIBIOUS FORCE FLAGSHIP	Support	29Jul46 PH	Own Power	SF Arrive 16Aug	02Oct46	03Oct46	DECON not required

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS APPLING APA-58 ATTACK TRANSPORT	Support	08Aug46 PH	Own Power	SF	22Nov46	13Dec46	Returned to National Defense Reserve Fleet 12Dec54; sold as scrap
ARD-29 NON-SELF-PROPELLED AUXILIARY FLOATING DRYDOCK	Support	16Sep46 PH	Towed	PH	18Feb47	18Feb47	Sold through SAP cash sale 01Mar77
ARDC-13 CONCRETE AUXILIARY FLOATING DRYDOCK	Target	N/A	N/A	N/A	N/A	N/A	Sunk 06Aug46 Bikini Atoll by Baker Shot
USS ARKANSAS BB-33 BATTLESHIP	Target	N/A	N/A	N/A	N/A	N/A	Sunk 25Jul46 Bikini Atoll by Baker Shot
USS ARTEMIS ATTACK CARGO SHIP	Support	18Aug46 PH	Own Power	SF Arrive Oct	20Nov46	27Dec46	Sold for scrap 1960s
ATA-124 AUXILIARY OCEAN TUG	Support	09Sep46 PH	Own Power Towed YF-385	PS	Unknown	18Dec46	Unknown
ATA-180 AUXILIARY OCEAN TUG	Support	08Sep46 PH	Own Power – Towed YF-733	PS	24Feb47	Unknown	Unknown
ATA-185 AUXILIARY OCEAN TUG	Support	08Sep46PH	Own Power	SD	13Dec46	18Jan47	Sold for commercial service 1971
ATA-187 AUXILIARY OCEAN TUG	Support	11Sep46 PH	Own Power	SD	06Nov46	22Nov46	SAP transfer 01Feb75
ATA-192 AUXILIARY OCEAN TUG	Support	08Sep46 PH	Own Power	SF	14Nov46	10Feb47	Sale 15Apr76

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
ATR-40 RESCUE OCEAN TUG	Support	08Sep46 PH	Own Power – Towed UF-991	SF	17Dec46	21Dec46	Unknown
ATR-87 RESCUE OCEAN TUG	Support	08Sep46 PH	Own Power	PS	13Dec46	04Jan47	Unknown
USS AVERY ISLAND AG-76 MISCELLANEOUS SHIP	Support	07Aug46 SF	Own Power	SF Arrive 21Aug	03Dec46	04Jan47	Transferred to MARAD 04Jan60
USS BANNER APA-60 ATTACK TRANSPORT	Target	N/A	N/A	N/A	N/A	N/A	Scuttled 16Feb48 near KA
USS BARROW APA-61 ATTACK TRANSPORT	Target	N/A	N/A	N/A	N/A	N/A	Scuttled 11May48 near KA
USS BARTON DD-772 DESTROYER	Support	10Aug46 PH	Own Power	SF Arrive 29Aug	02Nov46	18Dec46	Sunk as target off Norfolk, VA, 8Oct69
USS BAYFIELD APA-33 ATTACK TRANSPORT	Support	08Aug46 SF	Own Power	SF/PS Arrive SF 20Aug	07Dec46	10Feb47	DRMO sale for scrap 15Sept69
USS BEGOR APD-127 HIGH-SPEED TRANSPORT	Support	03Aug46 PH	Own Power	SD	30Sep46	25Jan47	Sold as scrap 16Nov76
USS BENEVOLENCE AH-13 HOSPITAL SHIP	Support	25Aug46 PH	Own Power	SF	24Sep46	01Apr47	Sunk in collision off SF, 25Aug65

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS BEXAR APA-237 ATTACK TRANSPORT	Support	29Aug46 PH/SP	Own Power	SD/SF Arrive SF 02Nov	24Jan47	01Feb47	MARAD exchange 19Feb82
USS BLADEN APA-63 ATTACK TRANSPORT	Target	30Aug47 PH	Own Power	SF Arrive 13Sep OAK	06Nov46	21Dec46	Decommissioned 26Dec46 Norfolk, VA; transferred to U.S. Maritime Commission 03Aug53
USS BLUE RIDGE AGC-2 AMPHIBIOUS FORCE FLAGSHIP	Support	30Jul46 PH	Own Power	SF/LA Arrive SF 15Aug	Unknown	22Nov46	Sold for scrap 26Aug60
USS BOTTINEAU APA-235 ATTACK TRANSPORT	Support	10Aug46 PH	Own Power	SF Arrive 21Aug	19Dec46	27Dec46	MARAD exchange 01Aug83
USS BOUNTIFUL AH-9 HOSPITAL SHIP	Support	27Jul46 PH	Own Power	No Record	27Sep46	27Sep47	Decommissioned 13Sep46 Seattle, WA
USS BOWDITCH AGS-21 SURVEYING SHIP	Support	27Sep46 PH	Own Power	SF Arrive 19Oct	20Nov46	20Nov46	Transfer to MARAD 4Mar88
USS BRACKEN APA-64 ATTACK TRANSPORT	Target	N/A	N/A	N/A	N/A	N/A	Scuttled 10Mar48 off KA
USCG BRAMBLE WAGL-392	Support	24Aug46 KA	Own Power	PH	Unknown	22Nov46	USCG vessel; Decommissioned May 2003

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS BRISCOE APA-65 ATTACK TRANSPORT	Target	N/A	N/A	N/A	N/A	N/A	Scuttled 06May48 NEAR KA
USS BRULE APA-66 ATTACK TRANSPORT	Target	N/A	N/A	N/A	N/A	N/A	Scuttled 11May48 near KA
USS BURLESON APA-67 ATTACK TRANSPORT	Support	05Aug46 PH	Own Power	NV	Unknown	14Oct46	Reserve 9Nov46
USS BUTTE APA-68 ATTACK TRANSPORT	Target	N/A	N/A	N/A	N/A	N/A	Scuttled 12May48 near KA
USS CARLISLE APA-69 ATTACK TRANSPORT	Target	N/A	N/A	N/A	N/A	N/A	Sunk 01Jul46 BA by Able Shot
USS CARTERET APA-70 ATTACK TRANSPORT	Target	N/A	N/A	N/A	N/A	N/A	Sunk by gunfire 19Apr48 in the Marshall Islands
USS CATRON APA-71 ATTACK TRANSPORT	Target	N/A	N/A	N/A	N/A	N/A	Sunk by gunfire 06May48 in the Marshall Islands
USS CEBU ARG-6 AMPHIBIOUS READY GROUP REPAIR SHIP	Support	23Aug46 PH	Own Power	PH/SF	16Dec46	21Dec46	Unknown

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS CHARLES P. CECIL DD-835 DESTROYER	Support	28Jul46 PH	Own Power	Unknown	Unknown	22Nov46	SAP transfer 01Aug80
USS CHICKSAW ATF-83 FLEET OCEAN TUG	Support	07Sep46 GU	Own Power	SF Arrive 21Feb47	13Jan47	18Jan47	SAP transfer 01May76
USS CHIKASKIA AO-54 OILER	Support	24Aug46 PH – Towed APL-34	Own Power	SF Arrive 17Sep	31Dec46	04Jan47	Disposed of through SAP 01Aug80
USS CHOWANDOC ATF-100 FLEET OCEAN TUG	Support	16Sep46 PH – Towed ARD-29	Own Power	PH/SF Arrive SF 08Aug47	Unknown	01Feb47	Sold through SAP cash sale 01Oct77
USS CLAMP ARS-33 SALVAGE SHIP	Support	05Sep46 PH	Own Power	SF/LA Arrive SF 22Oct	Unknown	22Nov46	Transfer to MARAD 01Feb99
USS COASTERS HARBOR AG-74 SURVEY SHIP	Support	17Aug46 PH	Own Power	LA	07Dec46	13Dec46	Stricken 1Apr60; disposition unknown
USS CONSERVER ARS-39 SALVAGE SHIP	Support	01Feb47 PH	Own Power	PH	04May47	11May47	Sold through SAP cash sale 01Apr94
USS CONYNGHAM DD-371 DESTROYER	Target	23Aug46 PH	Own Power	SF Arrive 11Oct	Unknown	Unknown	Scuttled 26Jul48 off SO CA

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS CORTLAND APA-75 ATTACK TRANSPORT	Target	30Aug47 PH	Own Power	SF Arrive 13Sep	06Nov46	16Dec46	Decommissioned 30Dec46 Norfolk, VA; Transferred to U.S. Maritime Commission 31Mar48; later sold as scrap
USS COUCAL ASR-8 SUBMARINE RESCUE VESSEL	Support	11Sep46 PH	Own Power – Towed SKIPJACK	SD	10Jan47	18Jan47	Target 19Jan91
USS CREON ARL-11 LANDING CRAFT REPAIR SHIP	Support	11Sep46	Own Power	LA	23Jan47	01Feb47	Unknown
USS CRITTENDEN APA-77 ATTACK TRANSPORT	Target	01Dec46 SF	Towed by USS CAHUILLA	SF Arrive Jan47	Unknown	Unknown	Sunk 5Oct48 off SO CA coast in 800 fathoms
USS CUMBERLAND SOUND AV-17 SEAPLANE TENDER	Support	01Aug46 SP	Own Power	LA	03Dec46	13Dec46	Sold 1Apr62
USS CURRENT ARS-22 SALVAGE SHIP	Support	02Dec46 PH 22Jul47 PH	Own Power	PH	06Feb47	17Feb47	DRMO scrap 01Sep74
USS DAWSON APA 79 ATTACK TRANSPORT	Target	N/A	N/A	N/A	N/A	N/A	Scuttled 19Apr48 near KA in 2,290 fathoms

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS DELIVER ARS-23 SALVAGE SHIP	Support	08Sep47 PH	Own Power – Towed LIME-STONE	SF Arrive 08Oct	20Dec46	27Dec46	Cash sale through SAP 01Aug79
USS DENTUDA SS-335 SUBMARINE	Target	28Aug46 PH	Own Power	SF/MI Arrive SF 14Oct	Unknown	Unknown	Decommissioned 11Dec46 at MI; used by 12th Naval District for training Naval reservists; sold for scrap 20Jan69
USS DIXIE AD-14 DESTROYER TENDER	Support	28Aug46PH	Own Power	SF Arrive 22Sep	02Oct46	22Nov46	Disposed of by MARAD 17Feb83
USS DUTTON AGS-8 SURVEYING SHIP	Support	25Sep46	Own Power	LA	18Dec46	10Jan47	Sold 21Feb50
USS ENOREE AO-69 OILER	Support	07Sep46 PH	Own Power – Towed APL-30	SF Arrive 04Oct	03Dec46	Unknown	Transfer to MARAD 1Feb59
USS ETLAH AN-79 NET LAYING SHIP	Support	02Sep46	Own Power	PS	18Dec46	21Dec46	Decommissioned 31May60
USS FALL RIVER CA-131 HEAVY CRUISER (FLAGSHIP)	Support	09Sep46 PH	Own Power	LA	23Dec46	27Dec46	Sold 28Aug72; Scrapped
USS FALLON APA-81 ATTACK TRANSPORT	Target	N/A	N/A	N/A	N/A	N/A	Scuttled 10Mar48 near KA

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS FILLMORE APA-83 ATTACK TRANSPORT	Target	28Aug46PH	Own Power	SF Arrive 05Nov	22Nov46	04Jan47	Decommissioned 24Jan47 Norfolk, VA; transferred to U.S. Maritime Commission 01Apr48
USS FLUSSER DD-368 DESTROYER	Support	09Sep46 PH	Own Power	PH	22Nov46	13Dec46	Sold 6Jan48
USS FULTON AS-11 SUBMARINE TENDER	Support	Unknown	Unknown	SF Arrive MI 18Sep	24Dec46	10Jan47	DRMO sale scrap 12Nov95
USS FURSE DD-882 DESTROYER	Support	Unknown	Unknown	LA	Unknown	22Nov46	SAP cash sale 31Aug72
USS GASCONADE APA-85 ATTACK TRANSPORT	Target	Unknown	Towed to SF	SF Arrive 27Jan47	N/A	N/A	Sunk 21Jul48 off SO CA in 1,300 fathoms
USS GENEVA APA-86 ATTACK TRANSPORT	Target	13Oct46 PH	Own Power	SF Arrive 04Nov	Unknown	04Jan47	Decommissioned 01Jan47 Norfolk, VA; transferred to U.S. Maritime Commission 02Apr48; transferred to NC reserve fleet Jul55; scrapped 02Nov66
USS GEORGE CLYMER APA-27 ATTACK TRANSPORT	Support	20Aug46 PH	Own Power	SD	22Nov46	07Feb47	Decommissioned 31Oct67

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS GILLIAM APA-57 ATTACK TRANSPORT	Target	N/A	N/A	N/A	N/A	N/A	Sunk 01Jul46 BA by Able Shot
USS GUNSTON HALL LSD-5 DOCK LANDING SHIP	Support	02Sep46 PH	Own Power	LA	08Jan47	10Jan47	SAP transfer 01May70
USS GYPSY ARSD-1 SALVAGE LIFTING SHIP	Support	10Sep46 PH	Own Power	PH/LA	09Jan47	19Jan47	DRMO Scrap Sale 01Jan74
USS HAVEN AH-12 HOSPITAL SHIP	Support	10Oct46 PH	Own Power	SF/LA Arrive SF 23Oct	14Feb47	Unknown	Transferred to MARAD 05Jun67
USS HENRICO APA-45 ATTACK TRANSPORT	Support	16Aug46 PH	Own Power	SF Arrive 29Aug	28Jan47	01Feb47	Decommissioned 14Feb68
USS HESPERIA AKS-13 GENERAL STORES ISSUE SHIP	Support	31Aug46 PH	Own Power	PH/SF Arrive SF 23Dec	28Dec46	04Jan47	MARAD sale 01Oct79
USS HUGHES DD-410 DESTROYER	Target	Unknown	Towed	PS/SF Arrive SF Post Dec46	Unknown	Unknown	Sunk as Target 16Oct48 off WA
USS INDEPENDENCE CVL-22 SMALL AIRCRAFT CARRIER	Target	Unknown	Towed	SF Arrive 16Jun47	Unknown	Unknown	Sunk as Target 26Jan51 off SF in 1,000 fathoms

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS INGRAHAM DD-694 DESTROYER	Support	10Aug46 PH/SD	Own Power	SF/PS Arrive 04Sep	19Nov46	21Nov46	Decommissioned 16JUL71
USS JAMES M. GILLISS AGS-13 SURVEYING SHIP	Support	20Aug46 PH	Own Power	SF Arrive 30Sep	13Nov46	13Nov46	Sold 17Jun60
USS JOHN BLISH AGS-10 SURVEYING SHIP	Support	20Aug46 PH	Own Power	SF Arrive 06Oct	15Oct46	22Nov46	Decommissioned 26AUG49; scrapped
USS KENNETH WHITING AV-14 SEAPLANE TENDER	Support	14Aug46 PH	Own Power	LA/SF Arrive Oakland 25Aug	11Dec46	21Dec46	Decommissioned 30Sep58
USS LAFFEY DD-724 DESTROYER	Support	10Aug46 PH	Own Power	SF ENT ARD-32 prior to 04Sep	02Nov46	18Dec46	Donated as museum and memorial 15Aug78
USS LAMSON DD-367 DESTROYER	Target	N/A	N/A	N/A	N/A	N/A	Sunk 01Jul46 BA
LCI-327 LANDING CRAFT INFANTRY SHIP	Target	N/A	N/A	N/A	N/A	N/A	Sunk 30Oct47 near KA
LCI-329 LANDING CRAFT INFANTRY SHIP	Target	N/A	N/A	N/A	N/A	N/A	Scuttled 16Mar48 near KA

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
LCI-332 LANDING CRAFT INFANTRY SHIP	Target	N/A	N/A	N/A	N/A	N/A	Scuttled 30Sep47 near KA
LCI-620 LANDING CRAFT INFANTRY SHIP		N/A	N/A	N/A	N/A	N/A	Sunk 10Aug46 off BA
LCI(l)-549 LARGE INFANTRY LANDING CRAFT	Target	Unknown	Own Power	SF Arrive Jun48	04Apr47	01Aug48	Towed to Port Chicago, CA, Jan49; sold Learner Company of Alameda 02Aug49
LCI(L)-615 LARGE INFANTRY LANDING CRAFT	Target	Unknown	Own Power	SF Arrive Jun48	30Jun47	17Aug48	Sold 19Aug49 to private party
LCI(L)-1062 LARGE INFANTRY LANDING CRAFT	Support	Unknown	Own Power	GU/PH	Unknown	04Jan47	Unknown
LCI(L)-1067 LARGE INFANTRY LANDING CRAFT	Support	09Sep46 GU	Own Power	GU	24Feb47	Unknown	Unknown
LCI(L)-1091 LARGE INFANTRY LANDING CRAFT	Support	09Sep46 GU	Own Power	GU	Unknown	11Dec46 EST.	Unknown
USS LIMESTONE IX-158 CONCRETE BARGE	KWAJALEIN ONLY	08Sep46	Towed BY USS DELIVER	N/A	Unknown	22Nov	Unknown

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS LOWRY DD-770 DESTROYER	Support	10Aug46 PH/SD	Own Power	SF Arrive 29Aug	06Nov46	04Jan47	SAP transfer 01Oct73
LSM-60 MEDIUM LANDING SHIP	Target – Suspended Shot Baker	N/A	N/A	N/A	N/A	N/A	Sunk 25Jul46 BA
USS LST-52 TANK LANDING SHIP	Target	N/A	N/A	N/A	N/A	N/A	Sunk by Gunfire Apr48 near KA in 2,280 fathoms
USS LST-125 TANK LANDING SHIP	Target	N/A	N/A	N/A	N/A	N/A	Sunk by gunfire 14Aug46 near BA
USS LST-133 TANK LANDING SHIP	Target	N/A	N/A	N/A	N/A	N/A	Sunk 11May48 near KA
USS LST-220 TANK LANDING SHIP	Target	N/A	N/A	N/A	N/A	N/A	Sunk 12May48 near KA
USS LST-388 TANK LANDING SHIP	Support	Unknown	Own Power	SF Arrive 14Oct	05Dec46	13Dec46	Disposed of by MARAD 7April48
USS LST-545 TANK LANDING SHIP	Target	N/A	N/A	N/A	N/A	N/A	Sunk 12May48 near KA
USS LST-661 TANK LANDING SHIP	Target	N/A	N/A	N/A	N/A	N/A	Sunk25Jul48 near KA
USS LST-817 TANK LANDING SHIP	Support	31Aug46 PH	Own Power	SF Arrive PT HUE 09Oct	21Nov46	22Nov46	Sold for scrap 25May48
USS LST-861 TANK LANDING SHIP	Support	02Sep46 PH	Own Power	SF Arrive 02Oct	06Dec46	13Dec46	Sold for scrap 10Jun48

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS LST-871 TANK LANDING SHIP	Support (did not enter BA)	09Aug46 SF	Own Power	SF	N/A	22Nov46	DECON not required
USS LST-881 TANK LANDING SHIP	Support	31Aug46 PH	Own Power	SF Arrive 02Oct ENT HP BY 01Nov	13Dec46	23Dec46	Sold for scrap 24Nov47
USS LST-989 TANK LANDING SHIP	Support	09Aug46 PH	Own Power	SF Arrive 30Aug	19Nov46	22Nov46	Sold for scrap 25Jun48
USS MayRANT DD-402 DESTROYER	Target	N/A	N/A	N/A	N/A	N/A	Sunk 04Apr48 near KA
USS MENDER ARSD-2 SALVAGE LIFTING SHIP	Support	04Sep46 PH	Own Power – Towed YW and LCT-1078	LA	03Jan47	Unknown	DRMO scrap sale 01Jan74
USS MOALE DD-693 DESTROYER	Support	10Aug46 PH/SD	Own Power	SF Arrive 04Sep	19Nov46	11Dec46 (PS)	DRMO scrap sale 01Dec74
USS MOUNT MCKINLEY AGC-7 AMPHIBIOUS FORCE FLAGSHIP	Support	10Aug46 PH	Own Power	SD/SF Arrive SF 26Aug	20Dec46	29Jan47	MARAD transfer 22Sept77
USS MUGFORD DD-389 DESTROYER	Target	N/A	N/A	N/A	N/A	N/A	Scuttled 22Mar48 near KA

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS MUNSEE ATF-107 SERVED AS OCEAN TUG	Support	02Sep46PH	Own Power	SF	18Nov46	01Apr47	Unknown
USS MUSTIN DD-413 DESTROYER	Target	N/A	N/A	N/A	N/A	N/A	Sunk by gunfire 28Apr48 near KA
NAGATO JAPANESE BATTLESHIP	Target	N/A	N/A	N/A	N/A	N/A	Sunk 30Jul46 Bikini Lagoon
USS NEVADA BB-36 BATTLESHIP	Target	Unknown	Towed	PH	Unknown	Unknown	Sunk 31Jul48 off Pearl Harbor
USS NEWMAN K. PERRY DD-883 DESTROYER	Support	04Aug46 PH/SD	Own Power	SD/SF Arrive SF 04Sep	17Jan47	25Jan47	SAP transfer 01Feb81
USS NEW YORK BB-34 BATTLESHIP	Target	Unknown	Towed	PH	Unknown	Unknown	Sunk 08Jul48 southwest of Pearl Harbor
USS NIAGARA APA-87 ATTACK TRANSPORT	Target	Unknown	Unknown	SF/KA Arrive SF 15Sep	06Nov46	10Nov46	ARR Norfolk, VA, 23Nov46; used to test explosive in Chesapeake Bay 1947-48; sold as scrap 05Feb50 to Northern Metals Company of Philadelphia
USS O'BRIEN DD-725 DESTROYER	Support	08Aug46 PH/SD	Own Power	SF Arrive 29Aug	06Nov46	19Dec46	Disposed of as target 01Dec72

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS ONEOTA AN-85 NET LAYING SHIP	Support	06Sep46 GU	Own Power	PH	11Dec46	Unknown	Unknown
USS ORCA AVP-49 SMALL SEAPLANE TENDER	Support	Unknown	Own Power	PH/SF Arrive SF 26Oct	11Dec46	13Dec46	SAP transfer January 1962
USS OTTAWA AKA-101 ATTACK CARGO SHIP	Support	02Aug46 PT HUE	Own Power	SF/PH Arrive SF 05Sep	13Sep46	13Sep46	14Mar47, disposition unknown
USS PALMYRA ARS(T)-3 SALVAGE CRAFT TENDER	Support	Unknown	Own Power	SF	22Nov46	04Jan47	Stricken 1June73
USS PANAMINT AGC-13 AMPHIBIOUS FORCE FLAGSHIP	Support	Unknown	Own Power	SF/LA Arrive SF 12Aug	22Nov46	22Nov46	DECON not required
USS PARCHE SS-384 SUBMARINE	Target	28Aug46 PH/SF	Own Power	SF by 11Dec MI RPTD 14Oct	Unknown	11Dec46	Towed to Naval Reserve docks in Oakland Feb48; used as Naval Reserve training ship; sold for scrap Jul70
USS PENNSYLVANIA BB-38 BATTLESHIP	Target	N/A	N/A	N/A	N/A	N/A	Sunk 10Feb48 near KA

TABLE 6-2 OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION							
Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS PENSACOLA CA-24 HEAVY CRUISER	Target	21Apr47PS	Towed BY USS HITCHITI	KA/PS	Unknown	Unknown	Sunk 10Nov48 off coast of WA in 1,400 fathoms
PGM-23 PATROL MOTOR GUNBOAT	Support	09Sep46PH	Own Power	PH	Unknown	Unknown	Decommissioned 1947
PGM-24 PATROL MOTOR GUNBOAT	Support	09Sep46 PH	Own Power	PH	13Feb47	13Mar47	Unknown
PGM-25 PATROL MOTOR GUNBOAT	Support	12Aug46G U	Own Power	NO	Unknown	28May47	Unknown
PGM-29 PATROL MOTOR GUNBOAT	Support	12Aug46 GU	Own Power	NO	Unknown	28May47	Unknown
PGM-31 PATROL MOTOR GUNBOAT	Support	12Aug46 GU	Own Power	PH/SF Arrive SF 30Jan47	17Jan47	25Jan47	Unknown
PGM-32 PATROL MOTOR GUNBOAT	Support	12Aug46 GU	Own Power	RP	Unknown	10Oct46	Unknown
USS PHAON ARB-3 BASE REPAIR SHIP	Support	03Sep46 PH	Own Power	LA	26Dec46	04Jan47	Sold 8Jul62
USS PILOTFISH SS-386 SUBMARINE	Target	N/A	N/A	N/A	N/A	N/A	Sunk 25Jul46 Bikini Lagoon

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS POLLUX AKS-4 STORES ISSUE SHIP	Support	20Aug46 PH	Own Power	PS/SF Arrive SF 11Sep	29Nov46	25Jan47	Stricken 01Jan69; disposition unknown
USS PRESERVER ARS-8 SALVAGE SHIP	Support	01Sep46 PH	Own Power	LA	08Dec46	04Jan47	Assigned to Naval Reserve training facility
USS PRESQUE ISLE APB-44 SELF-PROPELLED BARRACKS SHIP	Support	02Sep46 PH	Own Power	LA/SF Arrive SF 29Sep	12Dec46	21Dec46	Stricken 1May59; disposition unknown
PRINZ EUGEN GERMAN CRUISER	Target	N/A	N/A	N/A	N/A	N/A	Sunk 22Dec46 KA
USS QUARTZ IX-150 CONCRETE BARGE	Support	03Sep46 PH	Towed by OUX	PS	12Dec46	13Dec46	Unknown
USS RALPH TALBOT DD-390 DESTROYER	Target	N/A	N/A	N/A	N/A	N/A	Scuttled 22Mar48 near KA
USS RHIND DD-404 DESTROYER	Target	N/A	N/A	N/A	N/A	N/A	Scuttled 22Mar48 KA
USS ROBERT K. HUNTINGTON DD-781 DESTROYER	Support	10Aug46 PH	Own Power	PS	19Nov46	04Jan47	SAP transfer 01Oct73

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS ROCKBRIDGE APA-228 ATTACK TRANSPORT	Support	29Aug46	Own Power	SF Arrive 12Sep	06Dec46	13Dec46	Sold for scrap 27May69
USS ROCKINGHAM APA-229 ATTACK TRANSPORT	Support	29Aug46 PH	Own Power	SF Arrive 12Sep	04Dec46	18Dec46	Disposed of by MARAD 2Oct79
USS ROCKWALL APA-230 ATTACK TRANSPORT	Support	19Aug46 PH/SP	Own Power	SF Arrive 10Sep	17Dec46	27Dec46	MARAD transfer 1Aug83
USS ROLETTE AKA-99 ATTACK CARGO SHIP	Support	30Aug46 PT HUE	Own Power	SD	28Jan47	01Feb47	MARAD transfer 1Jul60
USS SAIDOR CVE-117 ESCORT AIRCRAFT CARRIER	Support	04Aug46 PH	Own Power	SD	28Jan47	01Feb47	Sold for scrap 22Oct71
USS SAINT CROIX APA-231 ATTACK TRANSPORT	Support	02Aug46 PH to SD to SF	Own Power	SD/SF Arrive SF 17Aug	22Nov46	10Jan47	MARAD transfer 15Nov79
SAKAWA JAPANESE LIGHT CRUISER	Target	N/A	N/A	N/A	N/A	N/A	Sunk 02Jul46 Bikini Lagoon
USS SALT LAKE CITY CA-25 HEAVY CRUISER	Target	PH	Towed to PS by TAKELMA and HITCHITI	PS	Unknown	Unknown	Sunk by torpedoes 25May48 off San Clemente, CA, in 2,000 fathoms

TABLE 6-2 OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION							
Ship	**Function**	**Return Date/To**	**Method**	**DECON**	**OP Clear**	**Final Clear**	**Comments/ Final Disposition**
USS SAN MARCOS LSD-25 DOCK LANDING SHIP	Support	Unknown	Own Power	SF Arrive 02Oct	24Oct47	18Jan47	SAP transfer 01Aug74
USS SARATOGA CV-3 AIRCRAFT CARRIER	Target	N/A	N/A	N/A	N/A	N/A	Sunk 25Jul46 Bikini Lagoon
USS SEARAVEN SS-196 SUBMARINE	Target	Unknown	Unknown	SF (MI) Arrive SF 22Oct	Unknown	11Dec46	Sunk 11Sep48 off SO CA
USS SEVERN AO-61 OILER	Support	Unknown	Own Power	LA	Unknown	03Nov46	MARAD sale 22Jan79
USS SHAKAMAXON AN-88 NET LAYING SHIP	Support	06Sep46 GU	Own Power	PH	12Dec46	04Jan47	MARAD sale 16Sep77
USS SHANGRI-LA CV-38 AIRCRAFT CARRIER	Support	28Jul46 PH	Own Power	Unknown	Unknown	22Nov46	Scrapped 1988
USS SIOUX ATF-75 FLEET OCEAN TUG	Support	03Sep46 PH	Own Power	LA	23Nov46	04Dec46	SAP sale 01Aug73
USS SKATE SS-305 SUBMARINE	Target	28Aug46SF	Towed by FULTON to PH; Towed by CLAMP to SF	SF (MI) Arrive SF 22Oct	Unknown	Unknown	Decommissioned 11Dec46; scuttled 04Oct48 off San Diego coast in 515 fathoms

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS SKIPJACK SS-184 SUBMARINE	Target	11Sep46PH	Towed by COUCAL and USS PALMYRA	SF (MI) Arrive SF Oct	Unknown	Unknown	Sunk as target 11Aug48 iff SO CA in 700 fathoms
USS SPHINX ARL-24 LANDING CRAFT REPAIR SHIP	Support	14Dec46 WAKE ISLAND	Own Power	LA	14Feb47	23Apr47	Transfer to MARAD 02Jul90
USS STACK DD-406 DESTROYER	Target	N/A	N/A	N/A	N/A	N/A	Sunk by gunfire 24Apr48 off KA
USS SUNCOCK AN-80 NET LAYING SHIP	Support	02Sep46 PH	Own Power – Towed ETLAH	PS	12Dec46	13Dec46	DRMO scrap 28Jul71
USS SYLVANIA AKA-44 ATTACK CARGO SHIP	Support	27Aug46 PH	Own Power	PS/SF Arrive SF 21Sep	07Dec46 Seattle	Unknown	MARAD transfer 1Feb47; scrapped 1964
USS TELAMON ARB-8 BASE REPAIR SHIP	Support	15Aug46	Own Power – Towed LCT-1359	LA/SF Arrive SF 07Sep	12Dec46	21Dec46	DRMO sale 01Mar74
USS TOMBIGBEE AOG-11 GASOLINE TANKER	Support	05Sep46 PH	Own Power	LA	31Dec46	04Jan47	SAP transfer 7Jul72
USS TRIPPE DD-403 DESTROYER	Target	N/A	N/A	N/A	N/A	N/A	Sunk as target 03Feb48 near KA

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS TUNA SS-203 SUBMARINE	Target	28Aug46 PH	Own Power	SF Arrive 14Oct	Unknown	Unknown	Departed MI 20Sep48; scuttled 24Sep48 off SO CAL IN 1,160 FATHOMS
USS TURNER DD-834 DESTROYER	Support	25Jul46 PH	Own Power	Unknown	Unknown	22Nov46	Not contaminated – did not enter Bikini Lagoon after Baker
USS WAINWRIGHT DD-419 DESTROYER	Target	N/A	N/A	N/A	N/A	N/A	Sunk as target 05Jul48 near KA
USS WALKE DD-723 DESTROYER	Support	10Aug46 PH/SD	Own Power	SF Arrive 25 Aug	Unknown	23Oct46	DRMO scrap sale 01Mar75
USS WENATCHEE ATF-118 FLEET OCEAN TUG	Support	28Aug46 PH	Own Power	SF/LA Arrive 01Oct	13Nov46	13Nov46	SAP transfer date unknown
USS WHARTON AP-7 TRANSPORT SHIP	Support	28Aug46 SF	Own Power	PS/SF Arrive SF 07Sep	10Feb47 Seattle	Unknown	Stricken 26Mar47
USS WIDGEON ASR-1 SUBMARINE RECUS VESSEL	Support	11Sep46 PH	Own Power	SF Arrive 12Nov	13Dec46	10Jan47	Sold as scrap 1948
USS WILDCAT AW-2 WATER DISTILLING SHIP	Support	28Aug46 PH	Own Power	PS	09Jan47	10Jan47	Unknown

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS WILSON DD-408 DESTROYER	Target	N/A	N/A	N/A	N/A	N/A	Scuttled 08Mar48 near KA
YMS-354 MINESWEEPER	Support	21Oct46 GU	Own Power	GU	20Dec46	10Feb47	Unknown
YMS-358 MINESWEEPER	Support	21Oct46 GU	Own Power	GU	20Dec46	10Feb47	Unknown
YMS-413 MINESWEEPER	Support	21Oct46 GU	Own Power	GU	20Dec46	10Feb47	Unknown
YMS-385 MINESWEEPER	Support	21Sep46 GU	Own Power	GU	20Dec46	10Feb47	Unknown
YMS-413 MINESWEEPER	Support	21Oct46 GU	Own Power	GU	20Dec46	10Feb47	Unknown
YMS-463 MINESWEEPER	Support	21Oct46 GU	Own Power	GU	20Dec46	10Feb47	Unknown

TABLE 6-3A
APRIL 1947 CLIMATE CONDITIONS

April	Wind Speed (mph)		From Direction	
Day	**Average**	**Maximum**	**Average**	**Precipitation**
1	13	26	276	0.00
2	11	23	213	**0.10**
3	20	30	288	0.00
4	18	30	290	0.00
5	13	22	265	**0.03**
6	12	21	244	0.00
7	11	24	254	0.00
8	12	24	266	**0.08**
9	17	28	289	0.00
10	12	22	236	0.00
11	7	14	191	0.00
12	8	23	153	0.00
13	5	16	135	0.00
14	8	18	192	0.00
15	14	30	287	0.00
16	17	26	291	0.00
17	23	30	275	0.00
18	7	22	178	0.00
19	14	28	246	0.00
20	20	38	282	0.00
21	10	28	197	0.00
22	7	22	211	0.00
23	11	21	297	0.00
24	8	17	250	0.00
25	10	20	279	0.00
26	7	18	186	0.00
27	10	18	264	0.00
28	7	15	280	0.00
29	11	22	293	0.00
30	8	20	213	0.00

Source: Weather Station '023272 - San Francisco' 4.6 Miles Northwest of Shipyard.

The National Climatic Data Center (NCDC), Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Environmental Satellite, Data and Information Service (NESDIS).

TABLE 6-3B MAY 1947 CLIMATE CONDITIONS				
May	**Wind Speed (mph)**		**From Direction**	
Day	**Average**	**Maximum**	**Average**	**Precipitation**
1	7	20	190	0.00
2	14	26	297	0.00
3	18	26	291	0.00
4	16	22	294	0.00
5	11	17	269	0.00
6	9	22	187	0.00
7	9	20	216	0.00
8	20	30	282	0.00
9	20	38	291	0.00
10	19	28	299	0.00
11	10	24	190	0.00
12	11	20	272	0.00
13	11	24	269	0.00
14	9	25	172	0.00
15	9	20	209	0.00
16	13	30	251	0.00
17	15	24	287	0.00
18	10	22	246	0.00
19	13	22	293	0.00
20	12	20	310	0.00
21	12	25	267	0.00
22	7	36	145	0.00
23	9	17	220	0.00
24	12	24	267	0.00
25	9	18	203	0.00
26	12	20	195	**0.32**
27	12	18	253	**0.02**
28	15	25	287	0.00
29	11	20	273	0.00
30	11	18	230	0.00
31	10	18	202	**0.32**

Source: Weather Station '023272 - San Francisco' 4.6 Miles Northwest of Shipyard.

The National Climatic Data Center (NCDC), Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Environmental Satellite, Data and Information Service (NESDIS).

TABLE 6-3C JUNE 1947 CLIMATE CONDITIONS				
June	**Wind Speed (mph)**		**From Direction**	
Day	**Average**	**Maximum**	**Average**	**Precipitation**
1	11	26	210	**0.02**
2	11	18	257	0.00
3	11	18	256	0.00
4	6	16	173	**0.20**
5	9	20	185	**0.08**
6	5	15	123	**0.28**
7	11	30	192	**0.08**
8	10	17	211	**0.05**
9	20	30	284	0.00
10	20	31	282	0.00
11	18	30	291	0.00
12	14	25	223	0.00
13	17	28	296	0.00
14	12	24	262	0.00
15	9	17	222	0.00
16	10	26	252	0.00
17	14	28	288	0.00
18	11	24	246	0.00
19	15	32	280	0.00
20	18	33	282	0.00
21	19	26	322	0.00
22	10	20	223	0.00
23	16	26	304	0.00
24	13	22	302	0.00
25	10	22	252	0.00
26	14	24	256	0.00
27	20	30	272	0.00
28	13	24	250	0.00
29	10	20	196	0.00
30	14	24	272	0.00

Source: Weather Station '023272 - San Francisco' 4.6 Miles Northwest of Shipyard.

The National Climatic Data Center (NCDC), Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Environmental Satellite, Data and Information Service (NESDIS).

TABLE 6-3D
JULY 1947 CLIMATE CONDITIONS

July	Wind Speed (mph)		From Direction	
Day	**Average**	**Maximum**	**Average**	**Precipitation**
1	15	28	271	0.00
2	19	30	272	0.00
3	23	35	273	0.00
4	18	33	276	0.00
5	17	30	270	0.00
6	18	28	270	0.00
7	16	26	269	0.00
8	16	28	271	0.00
9	20	30	270	0.00
10	18	26	272	0.00
11	19	28	271	0.00
12	17	26	272	0.00
13	17	28	274	0.00
14	21	30	273	0.00
15	19	30	271	0.00
16	14	24	255	0.00
17	16	28	276	0.00
18	17	30	291	0.00
19	15	30	292	0.00
20	14	26	285	0.00
21	17	28	272	0.00
22	16	25	272	0.00
23	24	39	283	0.00
24	23	36	284	0.00
25	17	25	281	0.00
26	9	20	231	0.00
27	9	20	214	0.00
28	14	25	275	0.00
29	15	28	271	0.00
30	22	32	270	0.00
31	22	30	272	0.00

Source: Weather Station '023272 - San Francisco' 4.6 Miles Northwest of Shipyard.

The National Climatic Data Center (NCDC), Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Environmental Satellite, Data and Information Service (NESDIS).

TABLE 6-3E
AUGUST 1947 CLIMATE CONDITIONS

August	Wind Speed (mph)		From Direction	
Day	**Average**	**Maximum**	**Average**	**Precipitation**
1	17	26	271	0.00
2	14	28	268	0.00
3	13	22	281	0.00
4	10	25	235	0.00
5	16	30	305	0.00
6	16	26	276	0.00
7	17	32	271	0.00
8	16	28	285	0.00
9	17	26	285	0.00
10	10	20	229	0.00
11	11	18	240	0.00
12	11	25	239	0.00
13	13	24	274	0.00
14	13	22	291	0.00
15	10	22	272	0.00
16	11	25	272	0.00
17	12	24	295	0.00
18	12	23	303	0.00
19	10	23	250	0.00
20	16	26	232	0.00
21	24	35	272	0.00
22	15	26	253	0.00
23	11	22	294	0.00
24	12	21	256	0.00
25	14	18	270	0.00
26	10	18	243	0.00
27	8	18	237	0.00
28	8	20	196	0.00
29	9	20	212	0.00
30	12	25	289	0.00
31	9	22	223	0.00

Source: Weather Station '023272 - San Francisco' 4.6 Miles Northwest of Shipyard.

The National Climatic Data Center (NCDC), Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Environmental Satellite, Data and Information Service (NESDIS).

TABLE 6-4
SITES IMPACTED BY RETURN OF SHIPS FROM OPERATION CROSSROADS

Site	Purpose/Use
Building 103	Personnel Change House and Decontamination Center
Building 203	Fuel Oil Burning
Building 224	Sample/Material Storage
Building 253	Storage of Parts and Equipment Removed from Ships
Building 317	Stores/Animal Quarters
Building 503	Contaminated Laundry Facility
Building 506	Administrative and Laboratory
Building 507	Decontamination Center
Building 521	Fuel Oil Burning
Drydock 2	Ship Decontamination and Contaminated Equipment Removal
Drydock 3	Ship Decontamination and Contaminated Equipment Removal
Drydock 4	Ship Decontamination and Contaminated Equipment Removal
Drydock 5	Ship Decontamination and Contaminated Equipment Removal
Drydock 6	Ship Decontamination and Contaminated Equipment Removal
Drydock 7	Ship Decontamination and Contaminated Equipment Removal
Former NRDL Site on Mahan Street	Potential Storage Site for Contaminated Equipment
Gun Mole Pier	Contaminated Equipment Removal, Berthing of ex-INDEPENDENCE
IR-01/21	Potential disposal of ship decontamination wastes
IR-02	Potential disposal of ship decontamination wastes
IR-07	Potential disposal of ship decontamination wastes
IR-18	Potential disposal of ship decontamination wastes
Parcel F/Bay Waters	Discharged Material from Ship Decontamination
Ships' Berths	Ship Decontamination and Contaminated Equipment Removal

TABLE 6-5A
SITES IMPACTED BY NRDL USE OF G-RAM THROUGH 1955

Area	Purpose/Use
Building 103	Personnel Change House and Decontamination Center
Building 113	Sample Storage from Atomic Weapons Tests
Building 114 Site	Design Branch and Technical Library
Building 142	Sample Storage and Low Background Counting Laboratory
Building 214	Health Physics Counting Room
Building 224	Atomic Test Sample Storage
Building 274	Decontamination Training
Building 313 Site	Instrumentation Laboratory
Building 313A	RADIAC Development, Instrumentation Laboratory, Laboratory Offices, and Training
Building 317 Site	Temporary Animal Quarters
Building 322 Site	Instrumentation Laboratory
Building 351	Electronics Work Area, Sampling Laboratory, Research Laboratory, and Biological Research Laboratory
Building 351A	Instrumentation Calibration Facility and Chemical Technology Division
Building 364	Hot Cell, General Research Laboratory, and Research Animal Facility
Building 365	Animal Research Facility and Personnel Decontamination Storage
Building 366 (351B)	Administration and Stock Issue Section, General Laboratories, Instrument Calibration, and Chemical Research
Building 406	Receipt and Shipping of NRDL Materials
Building 500	NRDL Offices
Building 503 Site	Small Animal Exposure Facility and Radioactive Laundry Facility
Building 506 Site	Main Laboratory, Chemistry Laboratory, Nuclear Laboratory, Animal Experimentation, Radiochemistry Laboratory, Radioactive Waste Storage Tank, and Radioisotope Storage
Building 507 Site	Nucleonics Division, Animal Colony, Biological-Medical Laboratory, and Radioactive Laundry
Building 508 Site	Administration and Medical Services, Health Physics Division, and Project Offices

TABLE 6-5A
SITES IMPACTED BY NRDL USE OF G-RAM THROUGH 1955

Area	Purpose/Use
Building 509 Site	Annex A and Animal Irradiation Studies
Building 510 Site	Radiation Facility, Glass Blowing Shop, Sample Storage, Nucleonics Laboratory, and Physics Laboratory
Building 510A Site	X-Ray Facility, Thermal Research Facility, and Sample Storage
Building 517	Biological-Medical Laboratory, Cobalt Irradiation Facility, and Animal Exposure Facility
Building 520	Administration, Thermal Radiation Division, and Project Offices
Building 529	Underground Isotope Storage Vault and Radiation Experimentation
Building 704 Radioactive Materials Storage Site	Radioactive Materials Storage Area
Building 704 Animal Pens Site	Large Animal Research Colony
Building 707 and Kennels	Research Animal Colony
Building 707B	Animal Colony
Building 707C	Animal Colony
Building 707 Waste Triangle	Temporary Animal Pens and Receipt, Packaging and Storage of Radioactive Waste
Building 708	Research Animal Facility, Animal Psychology Study Colony, and Biological Research Laboratory
Building 710 Site	Sample Storage
Building 719	Incinerator; Possibly Used for Animal Disposal
Building 816	Two-meV Van de Graaff Generator and Chemical-Biological Laboratory
Experimental Shielding Range	Ship Shielding Studies
Gun Mole Pier	Radioactive Pavement Decontamination Study, Contaminated B-17 Aircraft Studies, Studies on ex-INDEPENDENCE, Portable Laboratory, Contamination Studies, Experimental Barge YFN-809, Decontamination and Laboratory Facility (YFNX-16), and Loading of Radioactive Waste Barge for Ocean Disposal
Shack 79 Site	Equipment Storage
Shack 80 Site	Equipment Storage

TABLE 6-5B
SITES IMPACTED BY NRDL USE OF G-RAM AFTER 1955

Area	Purpose/Use
Building 113A	Storage of Lead Sheet from Building 364
Building 364	Animal Irradiation Facility, Liquid Radioactive Waste Collection Facility, Engineering Test Equipment Storage, and Sample Storage
Building 365	Animal Research Facility and Personnel Decontamination Storage
Building 506 Site	Low Power Neutron Generator, Low Flux Neutron Laboratory, Chemistry Laboratory, Tritium Target Storage
Building 510 Site	Sample Storage and Physics Laboratory
Building 510A Site	Thermal Research Facility and Kevatron Facility
Building 517	Cobalt-60 Irradiation Facility and Animal Exposure Facility
Building 529	Neutron Generator, Low Flux Neutron Laboratory, and Cockroft-Walton Accelerator
Building 707 and Kennels	Research Animal Colony
Building 707 Waste Triangle	Temporary Animal Pens and Receipt, Packaging and Storage of Radioactive Waste
Building 708	Research Animal Facility, Animal Psychology Study Colony, and Biological Research Laboratory
Building 719	Incinerator; Possibly Used for Animal Disposal
Building 815	Consolidated Research Facility
Building 816	Van de Graaff Particle Generator
Building 820	Cyclotron Laboratory and Neutron Radiation Facility
Building 821	One-meV X-Ray Facility and X-Ray Laboratory
Building 830	Research Animal Breeding Facilities and Kennels
Building 831	Research Animal Breeding Facilities and Kennels
Experimental Shielding Range	Ship Shielding Studies
Gun Mole Pier	Radioactive Pavement Decontamination Study, Contamination Studies, Experimental Barge YFN-809, Decontamination and Laboratory Facility (YFNX-16), and Loading of Radioactive Waste Barge for Ocean Disposal
ICW 418	Warehouse Storage

TABLE 6-6
PHASE V ACTION SUMMARY

Parcel/Area	Action Taken
A/Building 821	Class 3 surveys performed. Slightly elevated levels found in drains. Class 1 surveys performed. No contamination found. Final status survey report submitted and finalized.
B/ Building 103	Class 3 surveys complete. Slightly elevated levels of Cs-137 found under building investigated and found to be below action levels. Final status survey report submitted to RASO.
B/Building 113 IR-42	Class 3 surveys complete. Gamma spectroscopy of concrete, firebrick, and hand kiln samples indicated NORM that did not exceed action levels. Firebricks and hand kiln disposed of. Final status survey report submitted to RASO.
B/Building 113A	Class 3 surveys complete. Thirteen elevated gamma scan locations investigated. NORM below background found. Final status survey report submitted to RASO.
B/Building 130 IR-24	Class 3 surveys complete. Eleven elevated gamma scan locations investigated. NORM below investigation level found and attributed to gravel. Final status survey report submitted to RASO.
B/Building 146 IR-23	Class 3 surveys complete. Twelve elevated gamma scan locations investigated. NORM below action level found. Historical research identified need for Class 1 survey. Report of actions completed submitted to RASO.
B/Drydock 6	Class 3 surveys complete. Ra-226 identified in samples within background range. Final status survey report submitted to RASO.
B/Drydock 6 Sediment	Sediment samples taken from the bottom centerline of drydock at 100-foot intervals along length of the drydock for gamma spectroscopy. Two of these samples were also processed by alpha spectroscopy. No contamination found. Results incorporated into Drydock 6 final status survey report
C/Building 211	Formerly used for storage of LLRW by NWT. Class 1 and 2 surveys complete. Elevated levels found in area not used for LLRW storage. Report of actions completed submitted to RASO.
C/Building 214 IR-28	Class 3 surveys complete. No elevated levels found. Final status survey report submitted to RASO.
C/Building 224 IR-28	Class 3 surveys complete. Final status survey report submitted to RASO.
C/Building 241	Class 3 surveys complete. Elevated areas found. Firebrick and potassium nitrate removed. Class 1 and 2 surveys complete. No elevated levels found. Final status survey report submitted to RASO.
C/Building 253	Class 3 surveys complete on first through sixth floors. Contamination found and remediated on fifth and sixth floor. Class 1 survey conducted on fifth and sixth floors and roof with additional surveys found contamination throughout building, ventilation shafts, piping, manholes, and on ledge outside of building. Roof and parts of ventilation system remediated. Report of actions completed submitted to RASO.
C/Building 271	Class 3 survey complete. Radium contamination found. Characterization, remediation, and Class 1 complete. Final status survey report submitted to RASO.

TABLE 6-6
PHASE V ACTION SUMMARY

Parcel/Area	Action Taken
C/Building 272	Class 3 survey complete. No contamination found. Final status survey report submitted to RASO.
C/Drydock 2	Seven radium devices found and removed. Class 1 and Class 2 surveys completed of areas with devices. Final status survey report submitted to RASO.
C/Drydock 3	Class 3 surveys complete. Eleven devices removed; 3 were Ra-226. Class 1 and Class 2 surveys completed of areas with devices. Final status survey report submitted to RASO.
C/Drydock 4	Class 3 surveys complete. Eleven devices removed; 1was Ra-226. Class 1 and Class 2 surveys completed of areas with devices. Final status survey report submitted to RASO.
D/Building 274 IR-35	Class 3 surveys complete. Investigated seven elevated gamma scan readings. Identified NORM that did not exceed action levels. Final status survey report submitted to RASO.
D/Building 313 Site IR-35	Class 3 surveys complete. Cs-137 contamination above action level found and remediated. Class 1 surveys complete. Final status survey report submitted to RASO.
D/Building 313A Site IR-35	Class 3 surveys complete. Cs-137 and Eu-152 contamination slightly above action levels found and remediated. Contaminated manhole found (see D/Building 313A Site Manhole). Class 1 survey complete. Final status survey report submitted to RASO.
D/Building 313A Site Manhole	Discovered during remediation of Building 313A site. Manhole no longer connected to any system. Water and sediment removed from manhole. Initial surveys and sampling found elevated readings in sediment and manhole. Sediment removed from manhole. Manhole removed. Class 1 surveys complete. Results incorporated into Building 313A Site report.
D/Building 322 Site	Class 3 surveys complete. Found Cs-137 and Eu-152 slightly above action levels. Characterization, remediation, and Class 1 survey complete. Final status survey submitted to RASO
D/Building 351 IR-34	Class 3 surveys complete. Second Class 3 surveys conducted as original background area (Building 411) determined to be impacted site. No contamination found. Final status survey report submitted to RASO.
D/Area Behind Building 351 between Buildings 323 and 324 IR-34	Class 3 surveys complete. Elevated Cs-137 found. Characterization and remediation complete. Class 1 surveys and review of data complete. Final status survey report submitted to RASO.
D/Building 351A IR-34	Class 3 surveys complete. Contamination identified in crawlspace. See below. Final status survey report submitted to RASO.
D/Building 351A Crawlspace	Contaminated pipe and soil removed and disposed. Class 1 surveys completed. NWT data review complete. Final status survey report submitted to RASO.
D/Building 364 IR-33	Continuation from prior interim project. Contamination found and remediated. Class 1 survey completed found elevated alpha and beta readings in Room 107 that require remediation. Results provided in report to RASO.
D/Building 364 Crawlspace	Continuation from prior interim project. Contaminated found and remediated. Class 1 survey completed. Final status survey report submitted to RASO.

TABLE 6-6
PHASE V ACTION SUMMARY

Parcel/Area	Action Taken
D/Area behind Buildings 351A and 364	Continuation from prior interim project. Characterization complete. Cs-137 contamination found and remediated. Investigated void space found at former Building 317 site and found no contamination. Class 1 survey identified additional area of contamination just outside of back steps from Building 351A. Results reported to RASO in Building 351A report.
D/Building 364 Trench	Continuation from prior interim project. Cs-137 contamination found. Additional pipe removed and disposed. Class 1 survey found additional elevated levels. Remediation and surveys complete. Results to be incorporated into Building 364 report.
D/Manhole Between Building 364/365	Cs-137 contamination found when tracing pipes from Building 364. Scraped and disposed of loose sediment. Elevated levels remain. Manhole sampled. Characterization indicates elevated levels in some manholes and lines. Results to be incorporated into report on sanitary and storm drain systems.
D/Manhole and Sewer Line on Cochrane Street	Manhole surveyed. Contamination found and removed. Sewer lines surveyed. Elevated levels found in lines and manholes. Results to be incorporated into report on sanitary and storm drain systems.
D/Building 365 IR-33	Class 3 surveys complete. No elevated readings found. Final status survey report submitted to RASO.
D/Building 366 (Former Building 351B)	Class 1 surveys complete. Identified contamination in ventilation system and floor drains. Results provided in report to RASO.
D/Building 383	Class 3 surveys complete. No elevated readings found. Safe found containing night vision device with thoriated lens that is being used by San Francisco Police Department. Final status survey report submitted to RASO.
D/Building 411	Class 3 surveys complete. Slightly elevated radium levels found on second floor in two areas. Elevated radium levels investigated and found to be within release limits. Final status survey report submitted to RASO.
D/Gun Mole Pier with Berths 15, 16, 17, 18, 19, and 20	Class 3 surveys complete. Elevated readings found on GMP. Sediment had elevated levels of Cs-137. Remediated areas on GMP-B. Class 1 surveys of remediated areas complete. Final status survey report for selected areas submitted to RASO.
D/Former NRDL Site on Mahan Street	Class 3 surveys complete. Elevated levels of Cs-137 and Ra-226 found. Characterization complete. Elevated readings found. New map located indicating much larger area. Additional characterization complete and reviewed by RASO. Remediation complete. Class 1 surveys complete. Final status survey report provided to RASO.
E/Building 406	Class 3 surveys complete. Elevated levels of Ra-226 found. Characterization and remediation complete. Class 1 surveys complete. Required recounts completed. One area remains to be remediated where a source had leaked onto the wood framing. Results provided in report to RASO.
E/Building 414	Class 3 surveys complete. Included areas under gravel. No elevated levels found. Final status survey report submitted to RASO.
E/Building 506 Site IR-14	Class 3 survey of building footprint complete. No elevated levels found. Historical research indicates need for Class 1 survey of building footprint, and former underground waste tank location outside of building. Results provided in report to RASO.

TABLE 6-6
PHASE V ACTION SUMMARY

Parcel/Area	Action Taken
E/Building 507 Site IR-38	Class 3 survey of building footprint complete. Elevated levels of radium found and remediated. Class 1 surveys of remediated area complete. Historical evidence indicates need for additional Class 1 surveys outside/adjacent to building footprint. Results provided in report to RASO.
E/Building 508 Site IR-38	Class 3 survey of building footprint complete. No elevated levels found. Historical evidence indicates need for Class 1 surveys of site and areas outside/adjacent to building footprint. Results provided in report to RASO.
E/Building 509 Site IR-38	Class 3 survey of building footprint complete. No elevated levels found. Historical evidence indicates need for Class 1 survey of site and areas outside/adjacent to building footprint. Results provided in report to RASO.
E/Building 510/510A Site IR-14	Class 3 survey of building footprint complete. No elevated levels found. Historical evidence indicates need for Class 1 survey of site and areas outside/adjacent to building footprint. Results provided in report to RASO.
E/Building 517 Site IR-70	Class 3 survey of building footprint complete. No elevated levels found. Historical evidence indicates need for Class 1 survey of site and areas outside/adjacent to building footprint. Results provided in report to RASO.
E/Building 520 Site IR-14	Class 3 survey of building footprint complete. No elevated levels found. Historical evidence indicates need for Class 1 survey of building footprint. Results provided in report to RASO.
E/Building 529 Site IR-14	Class 3 survey of building footprint complete. Historical evidence indicates need for investigation of underground isotope storage facility and Class 1 survey of building footprint. Results provided in report to RASO.
E/Area around Buildings 506, 520 and 529 Sites	Class 3 survey complete. Elevated levels found near foundation of Building 520. Investigation of elevated levels found sand with radium contamination and piping system with cesium contamination. Results provided in report to RASO.
E/Building 701 Site	Class 3 surveys complete. No elevated levels found. Results provided to RASO.
E/Building 707 IR-39	Asbestos removal complete. Surveys complete. Results provided to RASO.
E/Building 707 Concrete Pad	Remediated 3 areas previously. Area mowed and debris removed. Surveys complete. Recounts conducted. Elevated cesium-137 levels found underneath concrete pad. Results provided to RASO.
E/Building 707 Triangle	Area mowed and debris removed. Grids complete. Innovative Technology Solutions, Inc.'s removal of soil from IR-01/21 complete. Surveys complete. Results provided to RASO.
E/Building 707 Drains	Mobilization complete. Started tracing lines. Obstructed lines prohibit surveys internal characterization surveys. Samples show piping to be contaminated. Results provided to RASO.
E/Building 708	Mobilization complete. Asbestos contractor work complete. Surveys complete. No contamination found. Results provided to RASO.
E/Building 810	Class 3 surveys complete. No elevated levels found inside of building. Class 1 survey required as a result of finding contamination on loading dock. Results provided to RASO.
E/Shack 79 Site	Class 3 surveys complete. No elevated levels found. Historical evidence indicates need for Class 1 survey of site. Results provided to RASO.

TABLE 6-6
PHASE V ACTION SUMMARY

Parcel/Area	Action Taken
E/Shack 80 Site	Class 3 surveys complete. Elevated levels of Cs-137 found. Characterization and remediation complete. Class 1 and 2 surveys complete; located additional areas of cesium contamination. Results provided to RASO.
E/IR-01/21 (includes South Gate Range)	Area mowed and gridded. Surveys and sampling complete. Elevated areas identified. Results provided to RASO.
E/IR-04	Surveys complete on original boundary of site. Site boundaries expanded due to elevated readings at original boundary. Contamination found in railroad track areas. Results provided to RASO.

TABLE 6-7
RADIOLOGICAL SITE INVESTIGATION SUMMARY

	Other Investigations										Preliminary Assessment	Phase II Interim Investigations						Post-Phase IV Interim Investigation 1999-2000			Remedial Investigations				
Building No. or Area	**1946 and 1947 SDAT Surveys**	**1955 NRDL Surveys**	**1969 NRDL Survey for Disestablishment**	**1969 to 1970 AEC Surveys**	**1974 HPS Survey for Base Closure**	**April 1978 LFE Survey of Building 815**	**July 1978 RASO Survey of Building 815**	**September 1978 RASO Surveys of Other NRDL Buildings**	**1979 RASO Resurvey of Buildings 364, 815, and 816**	**1986 EPA NNPP Operations Investigation**	**1988 HLA Site Reconnaissance**	**1993 PRC H-3 Study**	**1993 CDHS H-3 Study**	**1993 EPA Study of Parcel E Soil**	**1994 EPA Petrographic Study of Parcel B**	**1994 Drydock 4 Surveys**	**1996 ATG Building 364 Peanut Spill Remediation**	**IDW Investigation**	**1999 October IT Corporation Investigation**	**2001 TtEMI Investigation**	**Phase I Radiological Investigation**	**Phase II 1Radiological Investigation**	**Phase III Radiological Investigation**	**Phase IV Radiological Investigation**	**2002 NWT Phase V Radiological Investigation**
Parcel A																									
813																									
816			✓	✓				✓	✓			✓	✓								✓				
819																									
821				✓																					✓
Parcel B																									
103																									✓
113																									✓
113A					✓			✓																	✓
114 Site																									
130																									✓
140 and Discharge Channel																									
142																									
146			✓																						
157																									
Drydock 5																									
Drydock 6	✓																								✓
Drydock 7																									
Submarine Base Area (IR-07)											✓				✓				✓		✓	✓			
Waste Oil Disposal Area (IR-18)															✓						✓	✓			
Parcel C																									
203																									
205 and Discharge Tunnel																									
211																									✓
214					✓																				✓
224																									✓

TABLE 6-7
RADIOLOGICAL SITE INVESTIGATION SUMMARY

	Other Investigations										Preliminary Assessment	Phase II Interim Investigations						Post-Phase IV Interim Investigation 1999-2000			Remedial Investigations				
Building No. or Area	**1946 and 1947 SDAT Surveys**	**1955 NRDL Surveys**	**1969 NRDL Survey for Disestablishment**	**1969 to 1970 AEC Surveys**	**1974 HPS Survey for Base Closure**	**April 1978 LFE Survey of Building 815**	**July 1978 RASO Survey of Building 815**	**September 1978 RASO Surveys of Other NRDL Buildings**	**1979 RASO Resurvey of Buildings 364, 815, and 816**	**1986 EPA NNPP Operations Investigation**	**1988 HLA Site Reconnaissance**	**1993 PRC H-3 Study**	**1993 CDHS H-3 Study**	**1993 EPA Study of Parcel E Soil**	**1994 EPA Petrographic Study of Parcel B**	**1994 Drydock 4 Surveys**	**1996 ATG Building 364 Peanut Spill Remediation**	**IDW Investigation**	**1999 October IT Corporation Investigation**	**2001 TtEMI Investigation**	**Phase I Radiological Investigation**	**Phase II 1Radiological Investigation**	**Phase III Radiological Investigation**	**Phase IV Radiological Investigation**	**2002 NWT Phase V Radiological Investigation**
Parcel C (Continued)																									
241																									✓
253					✓																				✓
271																									✓
272																									✓
Dry Dock 2										✓															✓
Dry Dock 3	✓									✓															✓
Dry Dock 4	✓									✓						✓					✓				✓
Parcel D																									
274																						✓			✓
313		✓																							✓
313A		✓																							✓
317																									✓
322		✓																							✓
351		✓																							✓
351A		✓			✓																		✓		✓
364			✓	✓				✓	✓												✓		✓		✓
365				✓				✓																	✓
366		✓																							✓
383																									✓
408																									
411																									✓
Gun Mole Pier																				✓					✓
500																									
503 Site																									
Mahan Street-NRDL																									✓

TABLE 6-7
RADIOLOGICAL SITE INVESTIGATION SUMMARY

	Other Investigations										Preliminary Assessment	Phase II Interim Investigations						Post-Phase IV Interim Investigation 1999-2000			Remedial Investigations				
Building No. or Area	**1946 and 1947 SDAT Surveys**	**1955 NRDL Surveys**	**1969 NRDL Survey for Disestablishment**	**1969 to 1970 AEC Surveys**	**1974 HPS Survey for Base Closure**	**April 1978 LFE Survey of Building 815**	**July 1978 RASO Survey of Building 815**	**September 1978 RASO Surveys of Other NRDL Buildings**	**1979 RASO Resurvey of Buildings 364, 815, and 816**	**1986 EPA NNPP Operations Investigation**	**1988 HLA Site Reconnaissance**	**1993 PRC H-3 Study**	**1993 CDHS H-3 Study**	**1993 EPA Study of Parcel E Soil**	**1994 EPA Petrographic Study of Parcel B**	**1994 Drydock 4 Surveys**	**1996 ATG Building 364 Peanut Spill Remediation**	**IDW Investigation**	**1999 October IT Corporation Investigation**	**2001 TtEMI Investigation**	**Phase I Radiological Investigation**	**Phase II 1Radiological Investigation**	**Phase III Radiological Investigation**	**Phase IV Radiological Investigation**	**2002 NWT Phase V Radiological Investigation**
Parcel E																									
406																									✓
414																									✓
500																									
506			✓	✓				✓															✓		✓
507		✓																					✓		✓
508		✓																					✓		✓
509																							✓		✓
510		✓																					✓		✓
510A																							✓		✓
517				✓				✓															✓		✓
520																									✓
521																									
529			✓	✓				✓															✓		✓
701																					✓				✓
704 RAM Area																									
704 Animal Pens																									
707				✓				✓																	✓
707B																									✓
707C																									
707 Triangle Area				✓																					✓
708																									✓
719																									
807																									
810																		✓							✓
Shack 79																									✓
Shack 80																									✓
Experimental Shielding Range																									✓

TABLE 6-7
RADIOLOGICAL SITE INVESTIGATION SUMMARY

	Other Investigations										Preliminary Assessment			Phase II Interim Investigations					Post-Phase IV Interim Investigation 1999-2000			Remedial Investigations				
Building No. or Area	**1946 and 1947 SDAT Surveys**	**1955 NRDL Surveys**	**1969 NRDL Survey for Disestablishment**	**1969 to 1970 AEC Surveys**	**1974 HPS Survey for Base Closure**	**April 1978 LFE Survey of Building 815**	**July 1978 RASO Survey of Building 815**	**September 1978 RASO Surveys of Other NRDL Buildings**	**1979 RASO Resurvey of Buildings 364, 815, and 816**	**1986 EPA NNPP Operations Investigation**	**1988 HLA Site Reconnaissance**	**1993 PRC H-3 Study**	**1993 CDHS H-3 Study**	**1993 EPA Study of Parcel E Soil**	**1994 EPA Petrographic Study of Parcel B**	**1994 Drydock 4 Surveys**	**1996 ATG Building 364 Peanut Spill Remediation**	**IDW Investigation**	**1999 October IT Corporation Investigation**	**2001 TtEMI Investigation**	**Phase I Radiological Investigation**	**Phase II 1Radiological Investigation**	**Phase III Radiological Investigation**	**Phase IV Radiological Investigation**	**2002 NWT Phase V Radiological Investigation**
Parcel E (Continued																									
Industrial Landfill (IR-01/21)											✓										✓	✓			✓
Bay Fill (IR-02)											✓			✓							✓	✓			
IR-03																									
IR-04																									✓
Salvage Yard																									
Shoreline																									✓
Parcel F																									
Underwater Areas										✓															
Ships 'Berths																									✓
Base Wide																									
Storm Drain Lines																						✓			✓
Sanitary Sewers																						✓			✓
Septic Systems/ Drain Fields																									✓
Off-Base Sites																									
ICW-418				✓																					
FUDS																									
815			✓	✓		✓	✓		✓																
820				✓																					
830																									
831																									

7.0 ASSESSMENT OF IMPACTED SITES

This section describes the methods and definitions used in Section 8.0 to categorize and assess the likelihood of residual contamination at impacted sites, the contaminated media involved, the potential for migration of contamination, and the recommended actions for each impacted site. Evaluations and definitions are based on guidance provided in MARSSIM.

Impacted sites were assessed based on the site's operation history and whether G-RAM was used, stored, or potentially disposed of at the site. Previous site surveys, studies, and investigations, when available, were also used to confirm or expand on the historical information.

Most of the historical radiological surveys and investigations at HPS were conducted prior to the publication of MARSSIM in December 1996; therefore, the terminology used in this section will not necessarily apply to historical documents. However, the Phase V Radiological Investigations that were conducted from January 2002 through June 2003 were conducted following MARSSIM guidelines. The protocols used for these surveys are described below and will be considered for future actions.

7.1 IMPACTED SITES

An impacted site is one that has a potential for radioactive contamination based on historical information or is known to contain radioactive contamination. Areas immediately adjacent to the primary impacted site may be included in this designation. Impacted sites include:

- Sites where radioactive materials were used or stored
- Sites where known spills, discharges, or other unusual occurrences involving radioactive materials have occurred, or may have occurred, that could have resulted in the release or spread of contamination
- Sites where radioactive materials might have been disposed of or buried

7.2 NON-IMPACTED SITES

A non-impacted site is one, based on historical documentation or results of previous radiological survey information, with no reasonable possibility for residual radioactive contamination.

7.3 IMPACTED SITE ASSESSMENTS

Assessments for each impacted site are provided in Section 8.0. These are based on the historical information and site surveys conducted prior to June 30, 2003. The assessments cover both media and migration pathways. These assessments may change in the future as the result of the implementation of recommended actions or location of additional historical information. The system used to assess the potential radiological contamination at an impacted site is detailed below.

7.3.1 Contamination Potential

The potential for residual radioactive contamination at each impacted site has been determined through a professional evaluation of historical information, previous survey results, and site reconnaissance. As recommended actions continue in the future, these assessments will change. Contamination potentials are categorized as:

- **Known-Restricted Access:** Radioactive contamination is known to exist at levels that could be hazardous without protective clothing, respiratory protection, or radiation monitoring
- **Known-Continued Access:** Low-levels of contamination exist, but the contamination is contained in a system, fixed on building surfaces, or is in generally inaccessible areas
- **Likely:** Residual radioactive contamination is expected but has not been confirmed
- **Unlikely:** Residual radioactive contamination is not expected but investigation is warranted
- **Unknown:** Residual radioactive contamination potentially exists but no clear indication of possible contamination levels or contaminants has been established
- **None:** Radioactive contamination has been fully assessed and removed, if necessary, and the site has been free-released by the Navy and regulators. The site remains classified as impacted but no further action is required.

7.3.2 Contaminated Media

Section 8.0 also categorizes and assesses different types of media at each impacted site that contain, or are suspected of containing, radioactive contamination. Previous survey data, historical information, and professional judgment were used to confirm the presence of contamination or determine contamination potential. Generic terms, as defined in MARSSIM, are used to categorize the types of material that would contain the contamination. For example, if a building contains radioactive contamination in concrete floor materials, the medium would be defined as "structures." To ensure that all potential media contamination has been evaluated, Section 8.0 includes an assessment for all media categories for each impacted site. The definitions for the types of media that could be contaminated are provided below.

- **Surface Soil:** The top layer of soil (to 6 inches bgs), fill, gravel, waste piles, concrete, or asphalt that is available for direct exposure, growing plants, resuspension of particles for inhalation, and mixing from human disturbances.
- **Subsurface Soil:** Solid materials and media found below the surface soils.
- **Surface Water:** Waters found in streams, rivers, lakes, and oceans as well as coastal tidal waters.
- **Groundwater:** Waters contained in subsurface materials and aquifers.
- **Air:** Atmosphere that becomes a migration pathway for resuspension and dispersal of radioactive contamination and contaminated media.
- **Structures:** A man-made surface(s) above the surface or contained within subsurface media.
- **Drainage Systems:** Sanitary drains, facility storm drains, or septic systems and leach fields. This category can include Bay sediments where drainage to the Bay occurs.

7.3.3 Contaminated Media Assessment

Section 8.0 provides an assessment of each contaminated media category at each impacted site. These ratings are determined during the evaluation of each media type. The ratings may change if additional historical information becomes available or further information is developed during the performance of surveys at the site. Ratings are defined below.

- **High:** Evidence of contamination in the media or migration pathway has been identified.
- **Moderate:** The potential for contamination in the media or migration pathway exists, although the extent has not been fully assessed.
- **Low:** The potential for contamination in the type of media or migration pathway is remote.
- **None:** Evidence of contamination in the specific media or migration pathway has not been found, or known contamination has been removed, and surveys indicate that the media or migration pathway meet today's release criteria.

7.3.4 Potential Migration Pathways

Migration pathways are the media or transport mechanisms that allow contamination to spread in the immediate vicinity of the contaminated media or off site. The assessment of each impacted site in Section 8.0 provides an evaluation of the potential migration of radioactive contamination. The type of potential or confirmed contaminated media and the radionuclides of concern were used to assess the potential migration pathways.

7.4 RECOMMENDED ACTIONS

A recommended action for each impacted site is also provided in Section 8.0. The recommendation is the result of the summary investigations conducted to determine radionuclides of concern, contamination potential, contaminated media, and potential migration pathways for exposure. The categories of recommended actions are defined below.

- **Emergency Action:** Immediate remediation or containment is required because the levels of radioactive contamination or radiation exposure are such that there is a high potential for significant exposure or release of radioactive materials to the public or the environment.
- **Scoping Survey:** Historical documentation indicates that radioactive materials may be present at an impacted site that has not had an initial evaluation previously performed, and a survey is required to determine if contamination exists. The intent of these surveys is to identify radionuclide contaminants, relative radionuclide ratios, and general levels and extent of contamination. These surveys usually include minimal surface scans, sampling, and dose rate assessments.

- **Characterization Survey:** Radioactive contamination has been confirmed within an impacted site by a scoping survey, and action must be taken to determine the extent of the contamination and to identify and define the extent of the radionuclides of concern. These surveys include facility or site in-depth surveys, sampling, monitoring, and analysis to provide the basis for acquiring necessary technical information to develop, analyze, and select appropriate cleanup techniques.
- **Remediation:** Radioactive contamination has been fully characterized within an impacted site, and remedial or removal action is necessary to comply with site-specific release criteria. Remedial action support surveys are performed while remediation is being conducted to guide the cleanup activities.
- **Final Status Survey:** Historical documentation and previous investigations or remediations indicate that radioactive contamination has been removed from an impacted site, and a survey needs to be conducted in accordance with MARRSIM guidelines to verify that an impacted site complies with applicable site release criteria. This survey includes the appropriate measurements and sampling that will define the radiological condition of a site in preparation for release. The surveys follow completion of decontamination or remediation activities, if any were performed, but can also be conducted to confirm that past radiological activities at an impacted site did not result in residual contamination.
- **Free Release:** Historical documentation and previous investigations and surveys indicate that all applicable release criteria have been met, and the site documentation is ready for review by the Navy and applicable regulators for future non-radiological usage. This may include confirmatory surveys by Navy or regulatory personnel to verify the results reported in the release documentation.
- **No Further Action:** An impacted site has been shown by the Navy and applicable regulatory agencies to meet release criteria.

7.5 MARSSIM SURVEY CLASSIFICATIONS

MARSSIM classifies surveys for impacted sites as Class 1, 2, or 3, depending on the potential for residual contamination. The classification is used to ensure that areas with higher potential for contamination receive a higher degree of survey effort with areas with the greatest potential for contamination receiving Class 1 surveys. The survey classification impacts scoping surveys, site characterization, and final status surveys and is instrumental in assessing free release documentation.

The survey classifications will be applied to recommended actions in Section 8.0, where appropriate. As surveys progress and data are analyzed, areas may be reclassified based on newly acquired survey data. For example, if contamination is found during a Class 3 survey, more extensive Class 1 or Class 2 surveys would typically be conducted. The three survey classifications are summarized below. Detailed descriptions are provided in Section 4.3.5.

7.5.1 Class 1 Surveys

Class 1 surveys are recommended for an impacted site that has a high potential for radioactive contamination, is known to have contamination, or had a prior remediation to remove radioactive contamination. This includes areas with contamination in excess of release limits based on a scoping or characterization survey or areas where previous Class 2 or 3 surveys found contamination above the release limits. Class 1 surveys cover 100 percent of the site.

7.5.2 Class 2 Surveys

Class 2 surveys are recommended for an impacted site that has a potential for radioactive contamination but the contamination is not expected to exceed the release limit. This includes areas known to contain minor isolated areas of contamination with low potential for exposure, buffer zones around Class 1 areas, or areas where previous Class 3 surveys found contamination. Class 2 surveys can cover 10 to 100 percent of the site.

7.5.3 Class 3 Surveys

Class 3 surveys are recommended for an impacted site that is not expected to contain residual contamination exceeding the release limit. This includes buffer zones around Class 1 or 2 areas or previously decontaminated and surveyed areas. The percentage of the site covered by Class 3 surveys is not standardized, and surveys may be conducted randomly.

7.6 PHASE V RADIOLOGICAL INVESTIGATION PROTOCOL

The Phase V Radiological Investigations were conducted within a standard protocol that applied MARSSIM guidelines during the survey process. Each site was assessed for potential radionuclides of concern using gamma scans, gamma static readings, alpha/beta static readings, dose rate measurements, alpha/beta swipes, tritium swipes (if appropriate), and sample analysis (alpha or gamma spectroscopy, or beta analysis, as appropriate). Extent of survey coverage included 100 percent for Class 1 surveys, 50 percent for Class 2 surveys, and 20 percent for Class 3 surveys. Static and dose rate measurements as well as swipe and samples were distributed accordingly within the percentage of the area surveyed. If contamination was found during a Class 3 survey, a 100 percent characterization survey was conducted followed by remediation, remedial action support surveys, and a Class 1 Final Status Survey. Site-specific information for the Phase V Investigation is provided in Table 6-7, and general information is provided in Section 8.0.

Due to contract realignment, the Phase V Radiological Investigations were suspended in June 2003. The recommendations for future action in Section 8.0 take into account the level of effort that was completed up to that point. The results of the Phase V investigations will be published in separate site-specific reports.

7.7 IMPACTED SITE EXAMPLE

A building, formerly used as a research laboratory, is identified as impacted. Undefined contamination has been found on interior building surfaces during a Class 3 scoping survey.

Contamination Potential: Known-Continued Access. The contamination has been confirmed but there is no indication of hazardous levels.

Potentially Contaminated Media

Surface Soil – Low: There is a slight likelihood that contamination from the building could be in the surface soils immediately surrounding the building.

Subsurface Soil – Low: There is a very slight likelihood that contamination from the surface soils could be in subsurface soils. Depending on the information available at the time of rating and professional evaluation of the information, this potential could be identified as “*None*.”

Surface Water – None: There is no surface water near the laboratory.

Groundwater – None: As the contamination is in the interior of the building, there is no potential for groundwater contamination.

Air – None: Contamination found in the building surfaces is insufficient to cause concern for airborne contamination. This rating would be based on the type and level of radioactivity identified in the contamination.

Structures – High: Contamination has been identified in the building.

Drainage Systems – High: With surface contamination on the building interior surfaces, there is a significant potential that the drainage systems (primarily sanitary) would be contaminated, as most laboratory rooms contain sink drains.

Migration Pathways for Exposure to the Public or Environment

Surface Soil – Low: The potential contamination in the surface soils would present a low probability for exposure to the public or off-site environment, as there is no probable transport mechanism to cause detectable levels of contamination to spread to off-site locations.

Subsurface Soil – None: There is limited means of initially contaminating subsurface soils; therefore, an exposure to the public or off-site environment is not likely.

Surface Water – None: The information on potentially contaminated media already established that there were no surface waters in the vicinity of the building. Contamination in the interior of a building would require transport of the contamination to surface waters by a secondary method such as runoff to a storm drain system, which is not likely to occur.

Air – None: Low levels of interior building surface contamination would require transport of a significant portion of the contamination outside the confines of the building, and then a secondary mechanism to carry the contamination off site.

Structures – Low to Moderate: Migration of the contamination in the building is likely. However, the potential for contamination to migrate to the public would be dependent on the access and security controls for the building.

Drainage Systems – Low: With contamination on interior building surfaces, the building drainage sanitary system may be contaminated. Low levels in drainage systems would be diluted by flow of non-contaminated liquids from other sources. The exposure potential from this contamination is minimal.

Recommended Actions: Class 1 Characterization Survey.

8.0 FINDINGS AND RECOMMENDATIONS

This section describes the buildings, structures, and open areas at HPS that are designated as "impacted" by radiological operations.

8.1 IMPACTED VERSUS NON-IMPACTED SITES

The scope of radiological operations at HPS has been assessed to determine whether these operations had a direct or indirect effect on buildings, structures, or open areas. These evaluations were based on guidance provided in MARSSIM to define all sites as either "impacted" or "non-impacted" by radiological operations. Impacted sites are those where radiological operations occurred, including the use, handling, packaging, or disposal of radioactive materials.

A summary of the former and current uses of impacted sites is provided in Table 8-1. A summary of the assessments and recommendations for the impacted sites is provided in Table 8-2.

8.2 SITE ASSESSMENTS

This section provides complete descriptions for each impacted site, including the former and current uses, radionuclides of concern, and previous radiological investigations of the site. This section also categorizes and defines the likelihood of residual contamination at impacted sites, the contaminated media involved, the potential for migration of G-RAM, and the recommended actions for each impacted site using the categories described in Section 7.0.

Table 8-2 provides a summary of potential contamination and migration pathway assessments and recommendations for all impacted sites detailed in Section 8.3.

8.3 PARCEL SUMMARY

HPS has been divided into six parcels: A, B, C, D, E, and F. Each of these parcels represents an area of the shipyard that has been delineated for future commercial, residential, or recreational purposes. Proposed future uses of each parcel are detailed in Figure 3-3. While individual sites in a parcel currently may be leased to private parties, a parcel is not transferred from the Navy until all requirements for unrestricted release of the property have been met. In general, the impacted sites lie within the defined parcel boundaries. There are, however, buildings identified outside of current Navy property or in areas that cross parcel boundaries. Details of impacted sites are provided in Sections 8.3.1 through 8.3.6 and in Tables 8-1 and 8-2.

8.3.1 Parcel A Impacted Sites

8.3.1.1 Building 813

Site Description: A large, 262-by-262-foot, four-story reinforced concrete, flat-roofed warehouse that includes banks of industrial steel sash in horizontal bands across all four stories, except at the front (south) of the first floor. The front has a bank of steel roll-up industrial doors extending the length of the concrete loading dock area. The loading dock is sheltered by a concrete canopy **(HRA-1118, pp 70-71)**. Figure 8.3.1.1 provides a map of the site location.

Former Uses: General warehouse and offices, supply storehouse **(HRA-1118, p 70)**, and Disaster Control Center **(HRA-1481; HRA-2829).**

Current Uses: Unoccupied.

Radionuclides of Concern: Sr-90 **(HRA-2829)**.

Previous Radiological Investigations: None.

Contamination Potential: Unlikely. A leaking 300-µCi Sr-90 check source was found in the Disaster Control inventory, and the Disaster Control Center was located in Building 813; however, spread of contamination from this source would be unlikely **(HRA-2829)**.

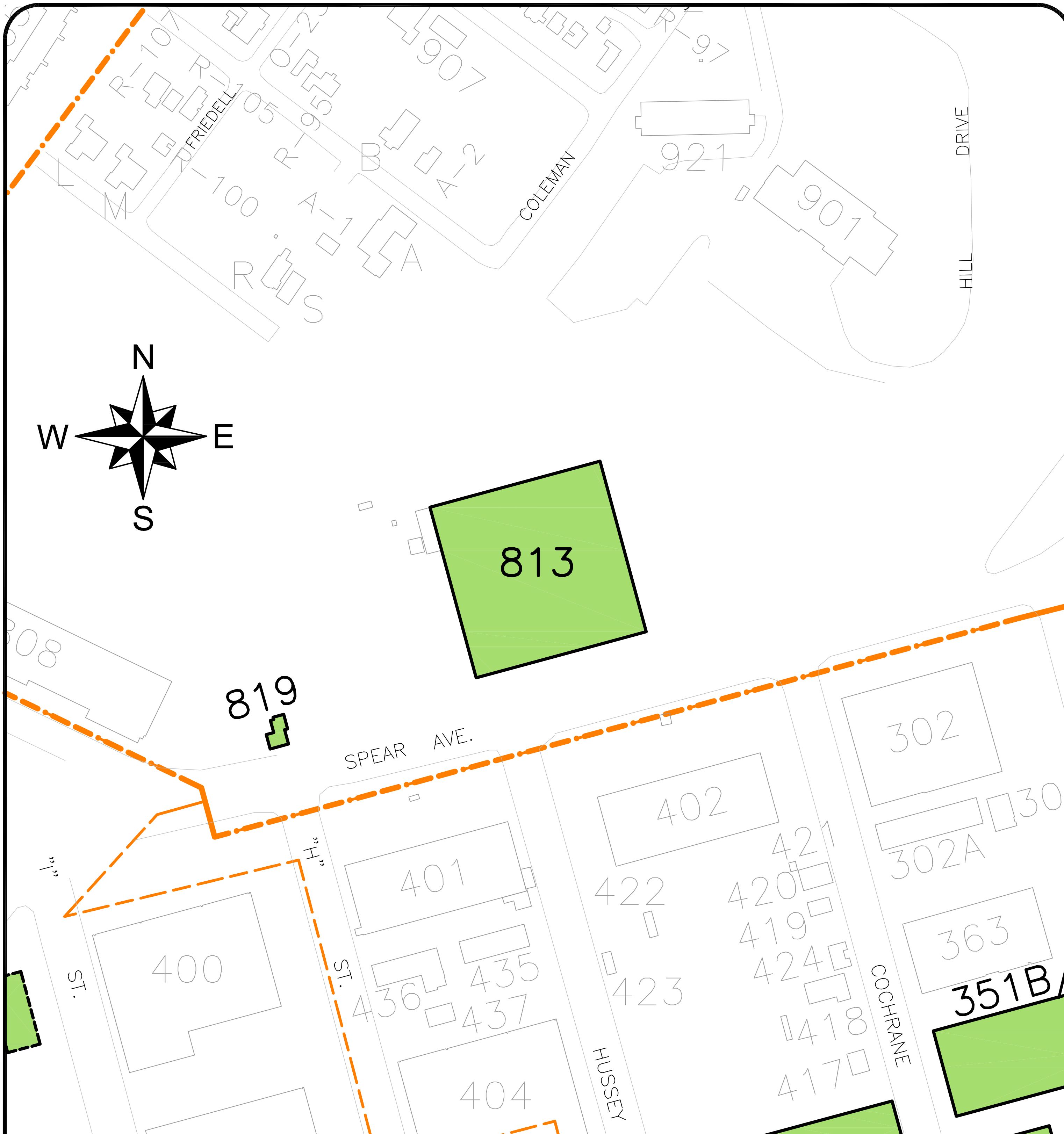
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Scoping Survey.



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200 0 200

Scale in Feet

- Impacted Site with Designation
- Impacted Site with Designation (Demolished)
- IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

Bldg. 813 Site Plan

January, 2004

Figure 8.3.1.1

8.3.1.2 Building 816

Site Description: Originally was a windowless, two-story concrete structure completed in December 1953 **(HRA-1051, p 1 of 3)**. Building wing to the right in the photograph was added from 1956 to 1957 and houses the neutron pit. The upper floor housed the Van de Graaff accelerator and its associated mechanical/electrical equipment. The ground floor was devoted to a laboratory, machine shop, and control room **(HRA-2113, p 7)**. One of the unique features of the building is a 4-foot-thick, 30-ton door at the south end. A steel addition was constructed to perform low intensity proton experiments **(HRA-177)**. Figure 8.3.1.2 provides a site plan, and Figure 8.3.1.2FP provides a floor plan.

Former Uses: Two-meV Van de Graaff Neutron Generator, chemical-biological laboratory, offices, and machine shop **(HRA-2113, P 7)**.

Current Uses: Unoccupied.

Radionuclides of Concern: H-3.

Previous Radiological Investigations:

2001 NWT H-3 survey. No activity detected.

1993 CDHS H-3 survey. Confirmed PRC results. EPA concurrence with results.

1993 PRC H-3 study. Samples obtained from outside building areas. No result exceeded the MDA value of 0.5 pCi/gm.

1992 PRC Phase I gamma walkover survey. No anomalies noted.

1979 NRC confirmatory survey. Area met criteria for the period.

1979 RASO H-3 survey. Building meets Regulatory Guide 1.86 limits.

1978 RASO survey. No activity detected.

1969 Final AEC clearance given 24 November 1969.

Contamination Potential: Unlikely.

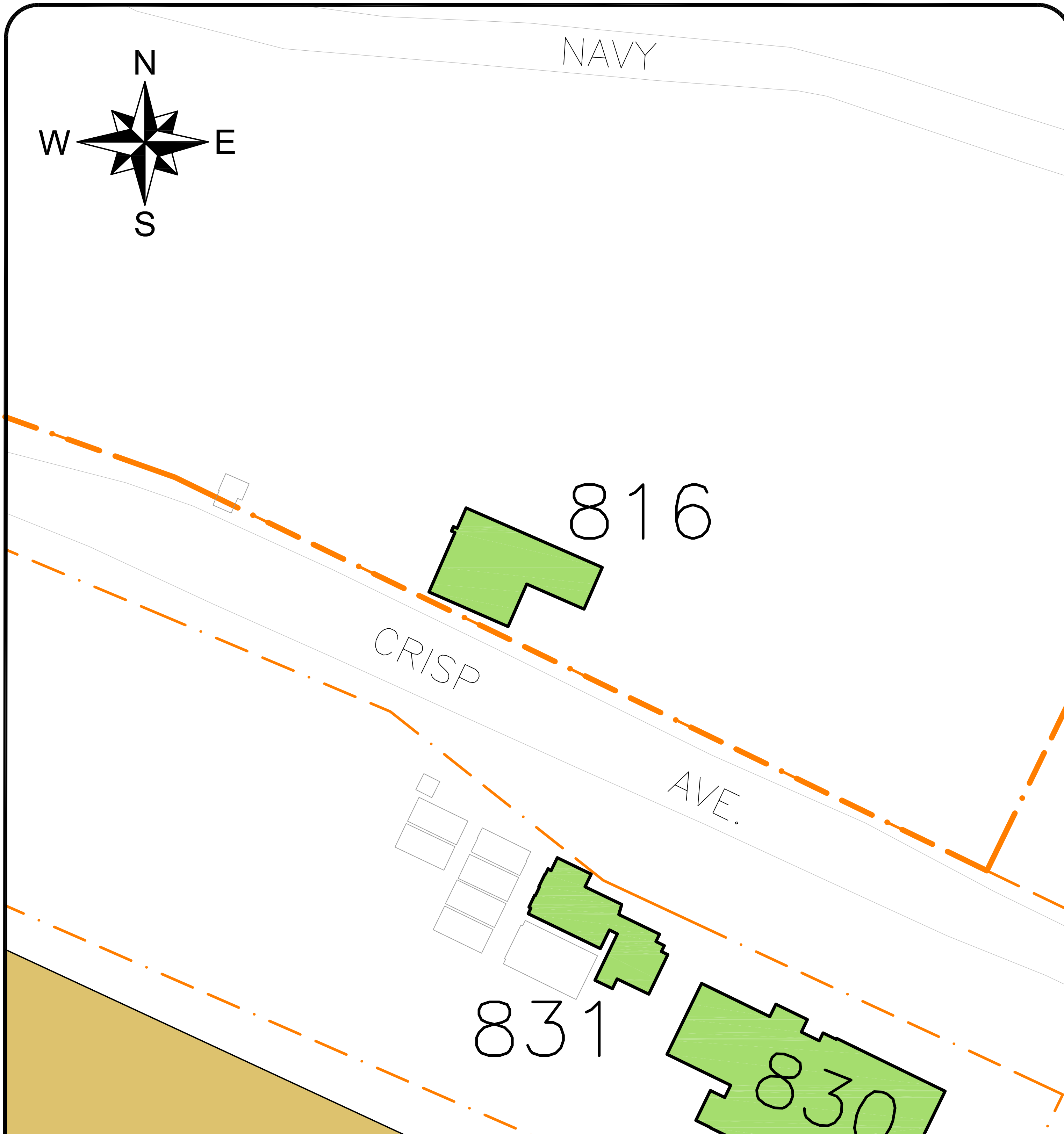
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Recommended Actions: No Further Action; released by RASO and CDHS.



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100 0 100
Scale in Feet

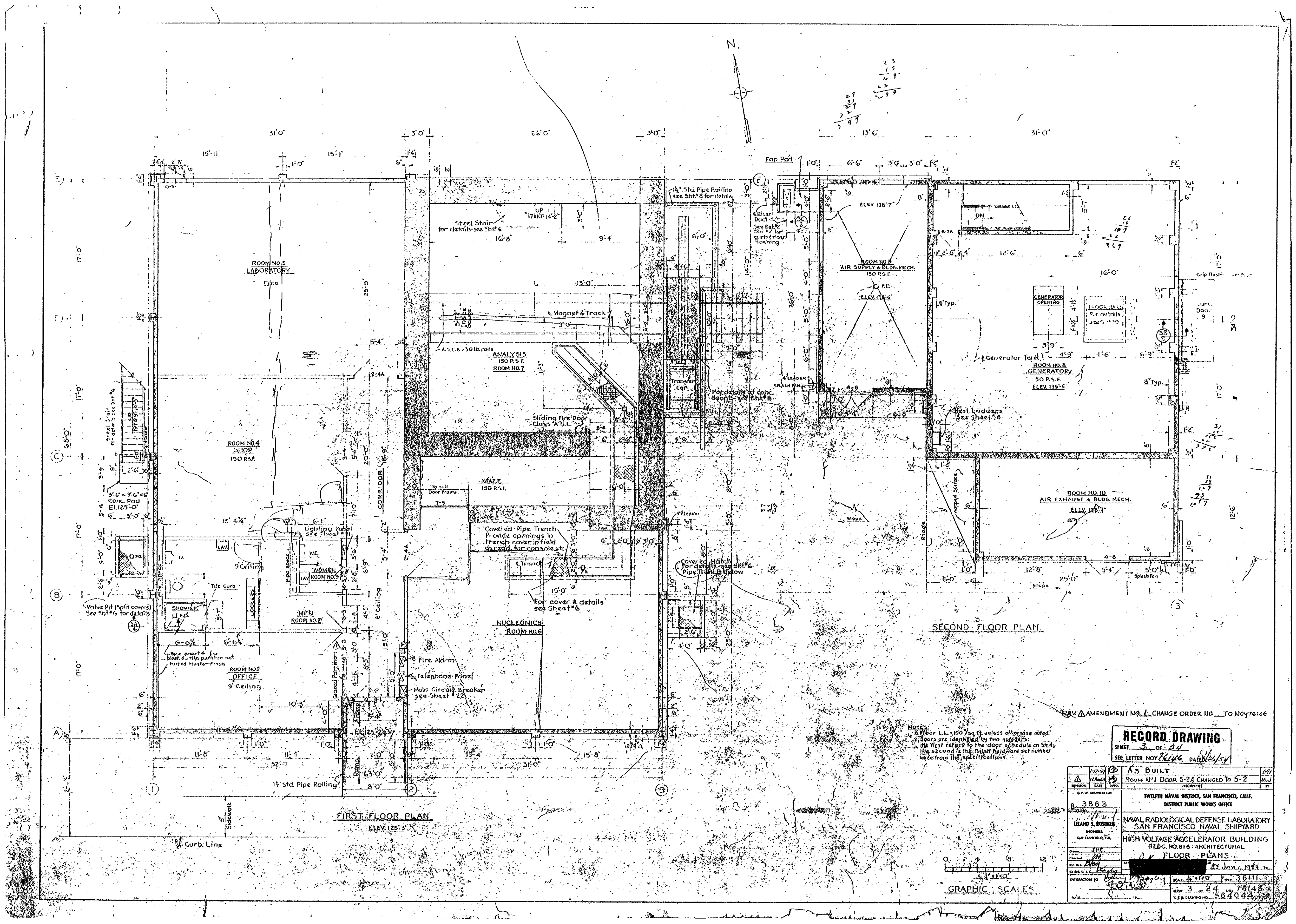
- Impacted Site with Designation
- Impacted Site with Designation (Demolished)
- IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

Bldg. 816 Site Plan

January, 2004

Figure 8.3.1.2



Notes:

Not to Scale. Background image per Map ID 99.

Hunters Point Naval Shipyard
San Francisco CA

Historical Radiological Assessment

May, 2003

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Figure 8.3.1.2FP
Building 816 - Floor Plan

8.3.1.3 Building 819

Site Description: The building, a sewage lift station containing dry and wet wells both approximately 20 feet deep, is constructed of reinforced concrete walls, with a flat concrete roofs, no windows, and a single access door. Figure 8.3.1.3 provides a site plan of Building 819.

Former Uses: Sewer Pump Station A.

Current Uses: In Use.

Radionuclides of Concern: Cs-137 and Ra-226.

Previous Radiological Investigations: None.

Contamination Potential: Likely. Prior to 1974, there was high potential for release of permissible quantities of licensed radioactive material and radium to the sanitary sewage system from shipyard and/or NRDL operations. Contamination was identified in sanitary sewer lines on Cochrane Street during the Phase V Radiological Investigations.

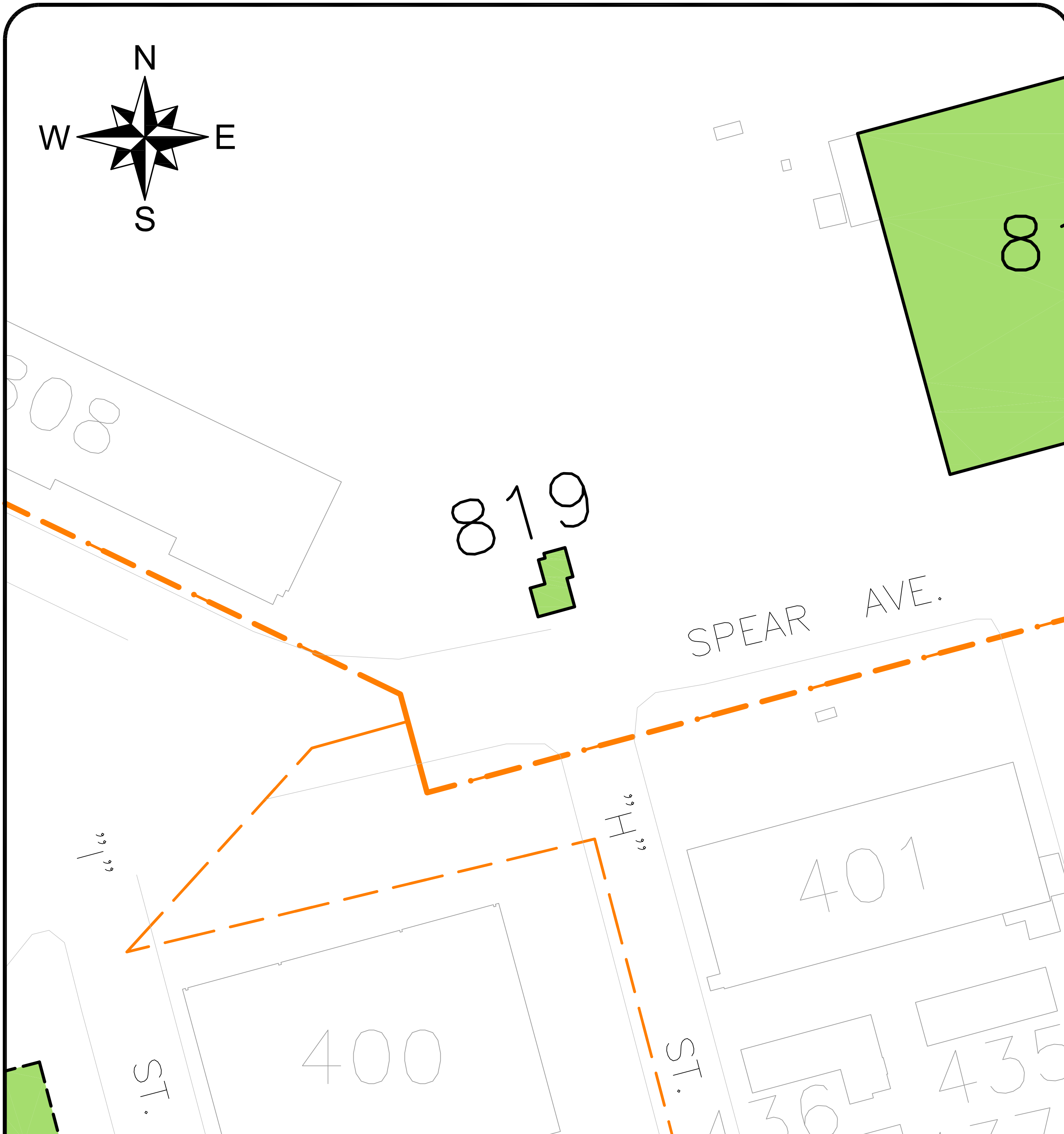
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Moderate – Piping/pumping system

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Moderate – Piping/pumping system

Recommended Actions: Scoping Survey.



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100 0 100

Scale in Feet

- Impacted Site with Designation
- Impacted Site with Designation (Demolished)
- IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

Bldg. 819 Site Plan

January, 2004

Figure 8.3.1.3

8.3.1.4 Building 821

Site Description: A two-story concrete laboratory building, used for the study of animal irradiation through electro-magnetic means (non-radionuclide generated). An electrical power substation is located outside of the western side of the building. Figure 8.3.1.4 provides a site plan.

Former Uses: One-meV X-ray generator **(HRA-2772, p 20)** and X-ray laboratory.

Current Uses: Unoccupied.

Radionuclides of Concern: None.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Survey results meet the release criteria.

1969 Final AEC clearance not needed **(HRA-2772, p 20).**

Contamination Potential: Unlikely.

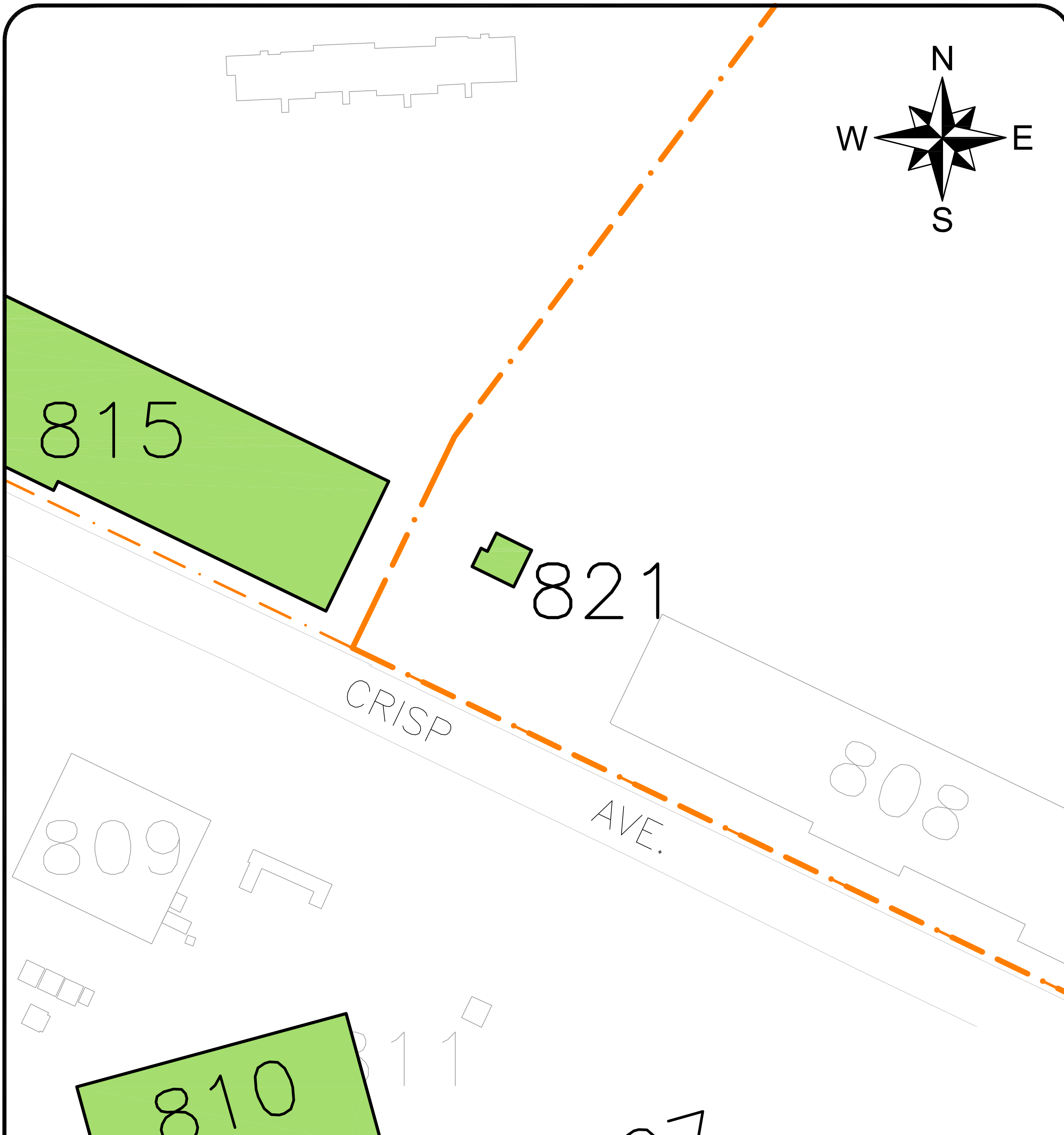
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures Site Description: None
Drainage Systems: None

Recommended Actions: No Further Action; released by RASO and CDHS.



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Scale in Feet

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- Impacted Site with Designation (Demolished)
- IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

Bldg. 821 Site Plan

January, 2004

Figure 8.3.1.4

8.3.2 Parcel B Impacted Sites

8.3.2.1 Building 103

Site Description: Built as a standard WW II wooden barracks, Building 103 is a long, narrow rectangular building topped by a shallow gabled roof with narrow eaves. It sits alongside a pair of similar buildings at the base of the hill **(HRA-1118, p 58)**. A site plan is provided in Figure 8.3.2.1.

Former Uses: Submarine barracks, 1951 **(HRA-2963)**; personnel decontamination center for OPERATION CROSSROADS personnel **(HRA-1483).**

Current Uses: Navy lease to San Francisco Redevelopment Agency, The Point (Artists).

Radionuclides of Concern: Cs-137, Pu-239, and Sr-90.

Previous Radiological Investigations:

2002	NWT Phase V investigations. Survey completed.

Contamination Potential: Unlikely.

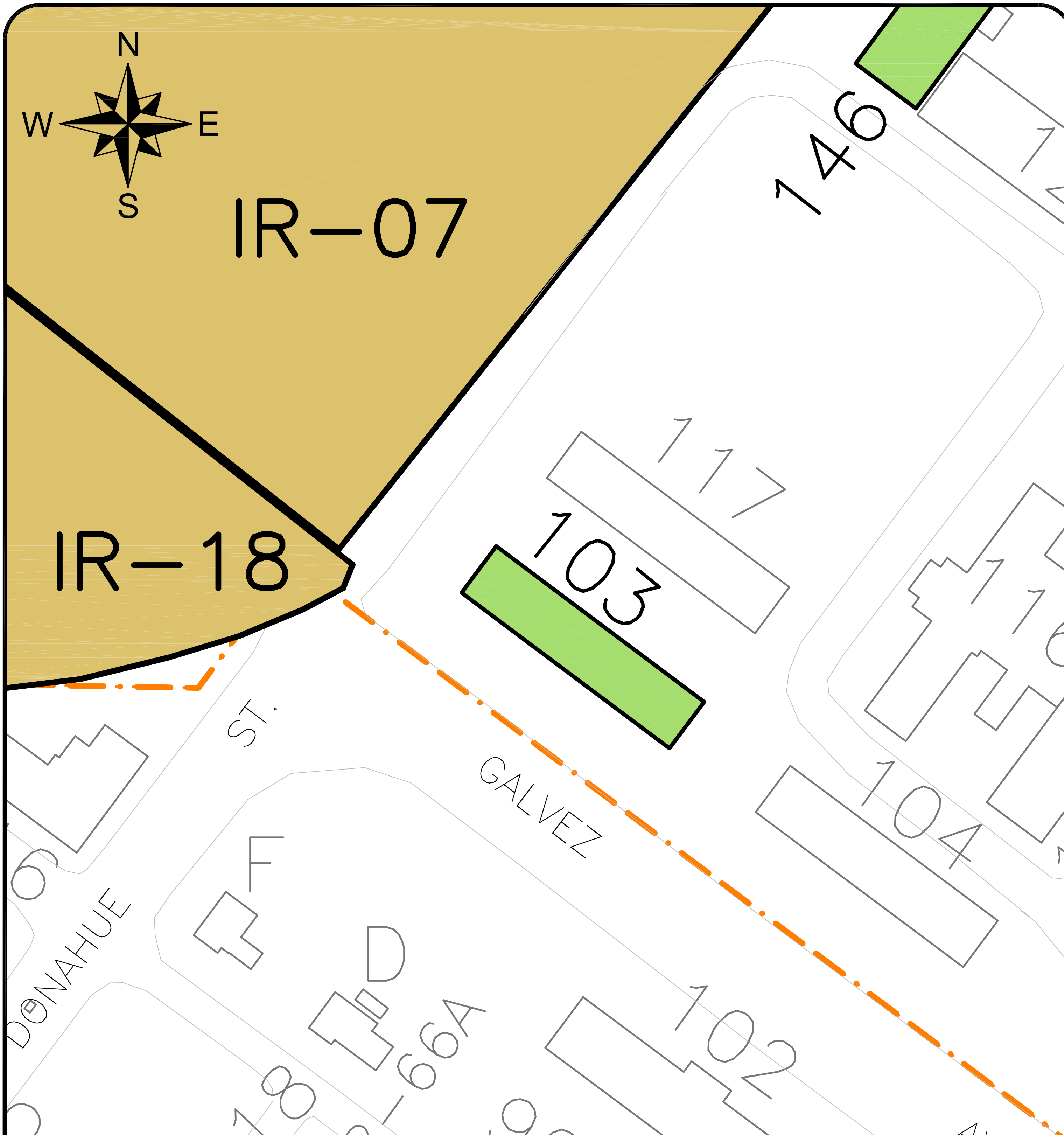
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Review Final Status Survey Report.



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100 0 100

Scale in Feet

- Impacted Site with Designation
- Impacted Site with Designation (Demolished)
- Impacted IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

Bldg. 103 Site Plan

January, 2004

Figure 8.3.2.1

8.3.2.2 Building 113

Site Description: Building 113 is a rambling three-story wood-framed shop located in the ex-submarine repair area. It is sided in horizontal boards and has a shallow gabled roof. The building has a central three-story element, a T-shaped two-story element, and a rectangular first story. A site plan is provided in Figure 8.3.2.2, and a floor plan is provided in Figure 8.3.2.2FP.

Former Uses: Tug maintenance, salvage diver facility, tug maintenance facility, torpedo storage and overhaul (1951-1964), and sample storage from atomic weapons tests **(HRA-2705 Encl A)**.

Current Uses: San Francisco Police Department storage building.

Radionuclides of Concern: Sr-90, Pu-239, and Cs-137.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Survey completed.

1996 PRC - No survey required. Determined that only sealed check sources were used.

Contamination Potential: Unlikely.

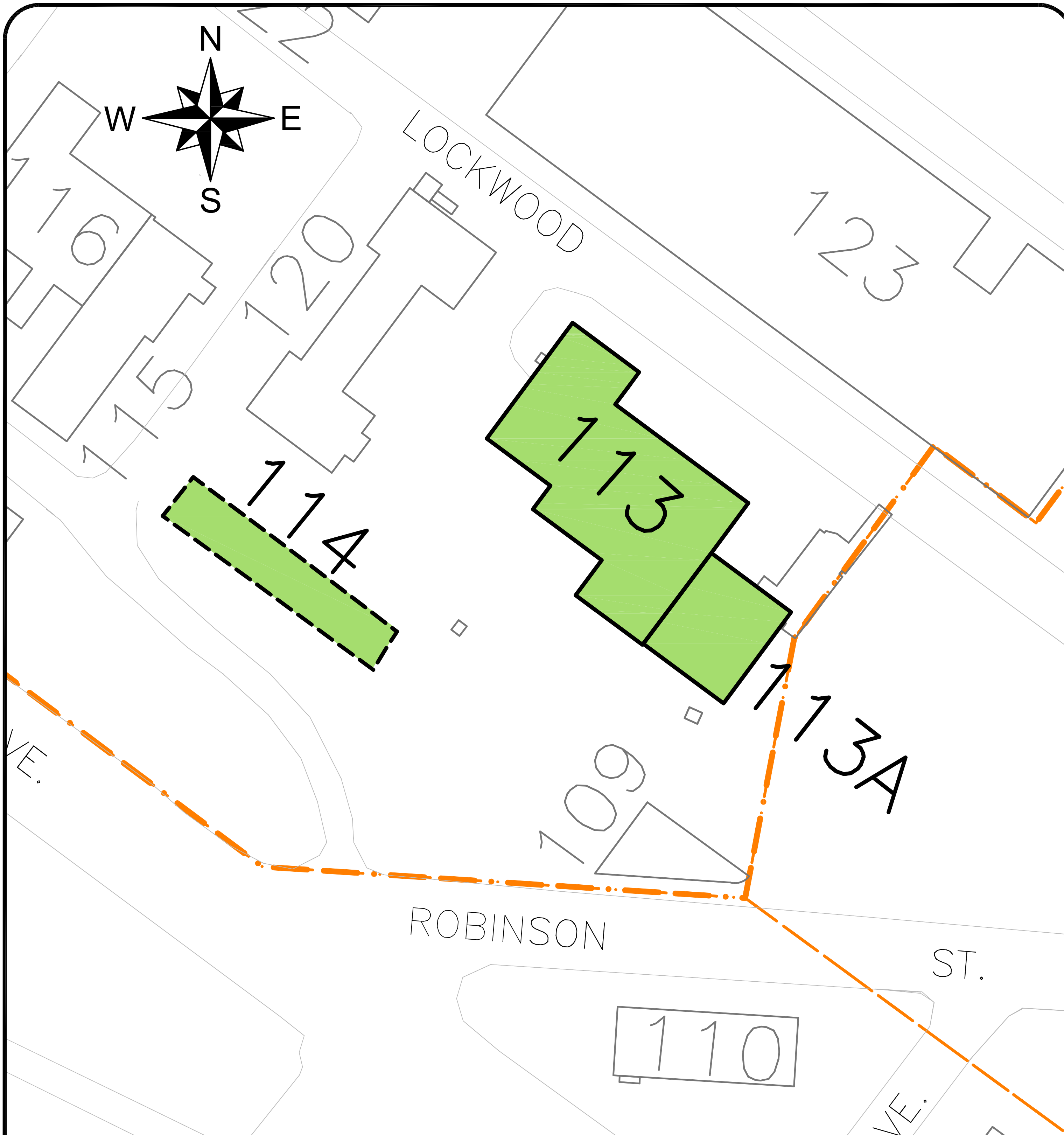
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Action: Review Final Status Survey Report.



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100 0 100

Scale in Feet

Impacted Site with Designation

Impacted Site with Designation (Demolished)

Impacted IR Site w/ Designation

Non - Impacted Building

Non-Impacted Building (Demolished)

Topographic Feature

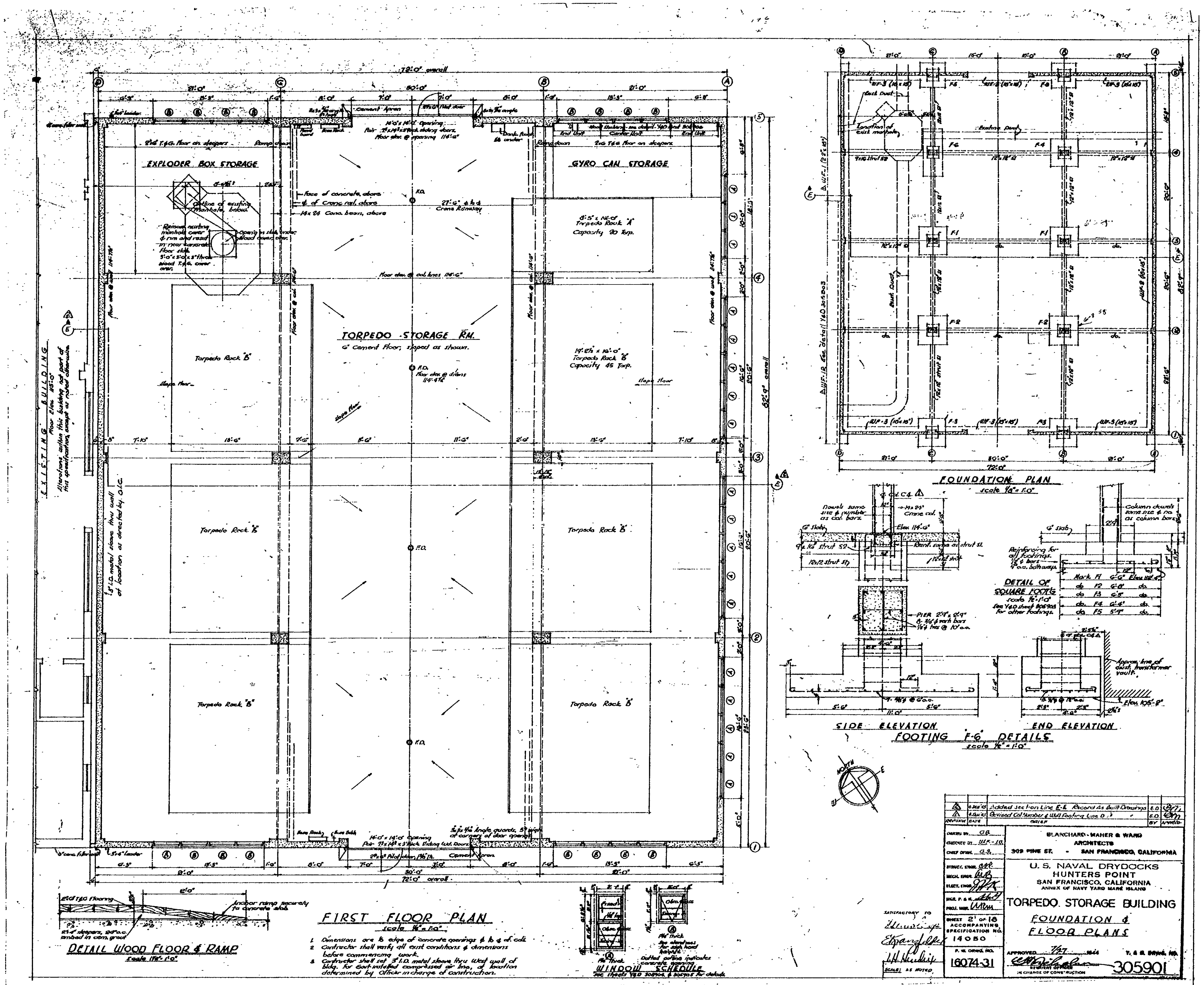
Parcel Boundary

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

Bldg. 113, 113A & 114 Site Plan

January, 2004

Figure 8.3.2.2



12 0 12

Scale in Feet

Notes:

Background image per Map ID 46.

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Historical Radiological Assessment

May, 2003

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Figure 8.3.2.2 FP
Building 113 - Floor Plan

8.3.2.3 Building 113A

Site Description: Building 113A is a 25-by-25-foot concrete storage vault enclosed by a corrugated, metal-sided, shallow gabled roofed structure that is immediately adjacent to Building 113 **(HRA-2798)**. The building is currently labeled as Building 114, although this is historically incorrect. Figure 8.3.2.2 above provides a site plan of Building 113A, and a floor plan is provided in Figure 8.3.2.3FP.

Former Uses: Torpedo storage building, Non-Destructive Test Facility (Radiography) **(HRA-1472 Supplement 1)**, Machine and Maintenance Shop, Shipyard Analytical Laboratory, Radioactive Material Storage Building, Radiographer's Vault, and Waste Disposal and Storage Facility. The building was also used to store sheet lead removed from Building 364 **(HRA-600, p 2)**.

Current Uses: Occupied by Smith-Emery.

Radionuclides of Concern: Cs-137 and Ra-226.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Survey completed.

1978 Scoping surveys by RASO.

1974 Shipyard closure survey. No detectable activity.

Contamination Potential: Unlikely.

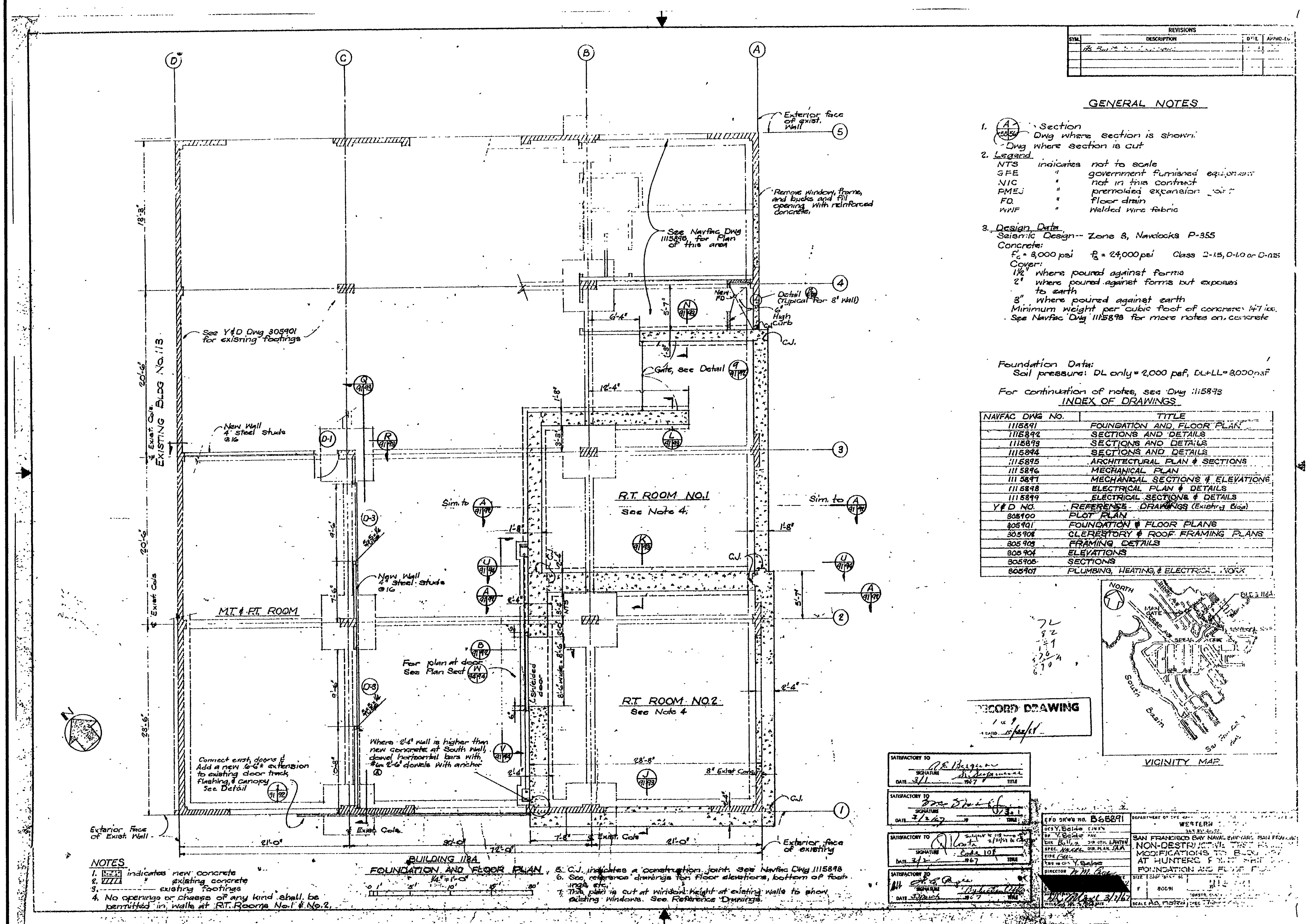
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Action: Review Final Status Survey Report.



12 0 12

Scale in Feet

Notes:

Background image per Map ID 42.

Hunters Point Naval Shipyard
San Francisco CA

Historical Radiological Assessment

May, 2003

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Figure 8.3.2.3 FP
Building 113A - Floor Plan

8.3.2.4 Building 114 Site

Site Description: Building has been demolished, and actual building descriptions are not available. It has been incorrectly identified as Building 113A in other documents. A site plan is provided in Figure 8.3.2.2 above.

Former Uses: NRDL Design Branch and Technical Library – 1951 **(HRA-2963)**.

Current Uses: Demolished.

Radionuclides of Concern: None.

Previous Radiological Investigations:

1996 PRC - no survey required, no radioactive material stored or used in building.

Contamination Potential: Unlikely.

Contaminated Media:

Surface Soil: Low
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Recommended Actions: Scoping Survey.

8.3.2.5 Building 130

Site Description: Building 130 is a wood-framed shop building located in the ex-submarine repair area. Built in 1944, the building differs from other shops in that it includes open sheds on both sides and an almost flat, shallow gabled roof. The building also includes wooden sliding industrial doors at either end. A site plan of Building 130 is provided in Figure 8.3.2.5.

Former Uses: Occupied by Protective Finishes Company (1994), PRC used the building as a LLRW storage area (Ra-226 and IDW in 1994) **(HRA-1118, p 58)**, Shop Service (1968 to 1973), pipe fitter shop, general shops, ship repair shop, machine shop, and metal working shop.

Current Uses: Environmental HAZMAT storage.

Radionuclides of Concern: Ra-226 and Cs-137.

Previous Radiological Investigations:

2002 NWT Phase V investigation. Elevated readings noted and attributed to naturally occurring radionuclides. Survey complete.

Contamination Potential: Unlikely.

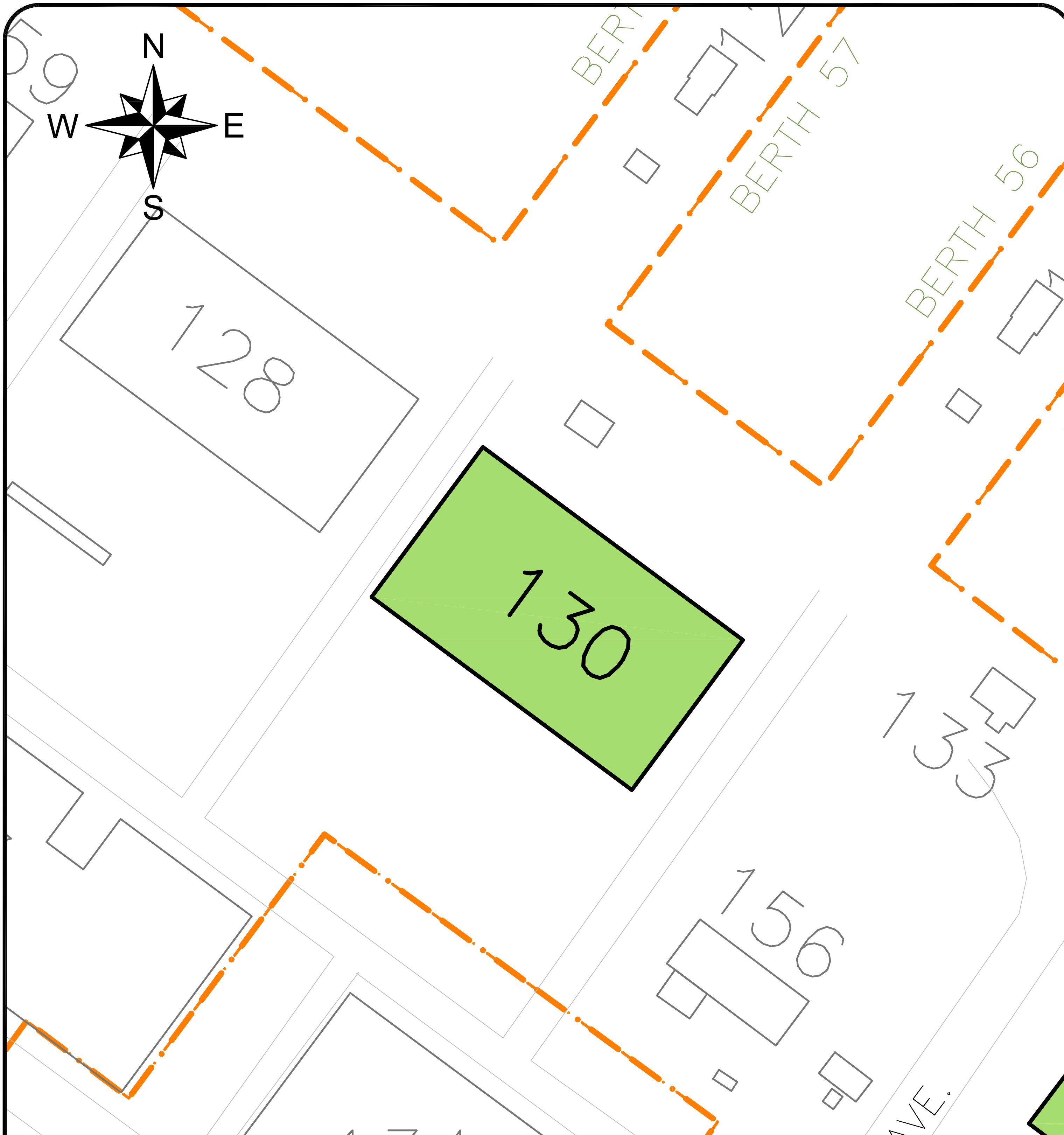
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Review Final Status Survey Report.



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100 0 100
Scale in Feet

Impacted Site with Designation
Impacted Site with Designation (Demolished)
Impacted IR Site w/ Designation
Non - Impacted Building
Non-Impacted Building (Demolished)
Topographic Feature
Parcel Boundary
All Berths shown are Impacted

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

Bldg. 130 Site Plan

January, 2004

Figure 8.3.2.5

8.3.2.6 Building 140 and Discharge Channel

Site Description: Building A is a one-story brick building shaped as a rectangle with a rounded eastern end resembling an apse. The building measures about 96 by 56 feet and is located north of Drydock 3, about midway along the drydock **(HRA-1117, p 133)**. A channel for water from Drydock 3 passes in a straight line north from the drydock through the pumphouse to the Bay **(HRA-4689)**. A site plan of Building 140 is provided in Figure 8.3.2.6.

Former Uses: Drydock Pumphouse No. 3 and discharge channel **(HRA-1117, p 133)**.

Current Uses: Unoccupied.

Radionuclides of Concern: Ra-226, Cs-137, Pu-239, and Sr-90.

Previous Radiological Investigations: None.

Contamination Potential: Unlikely.

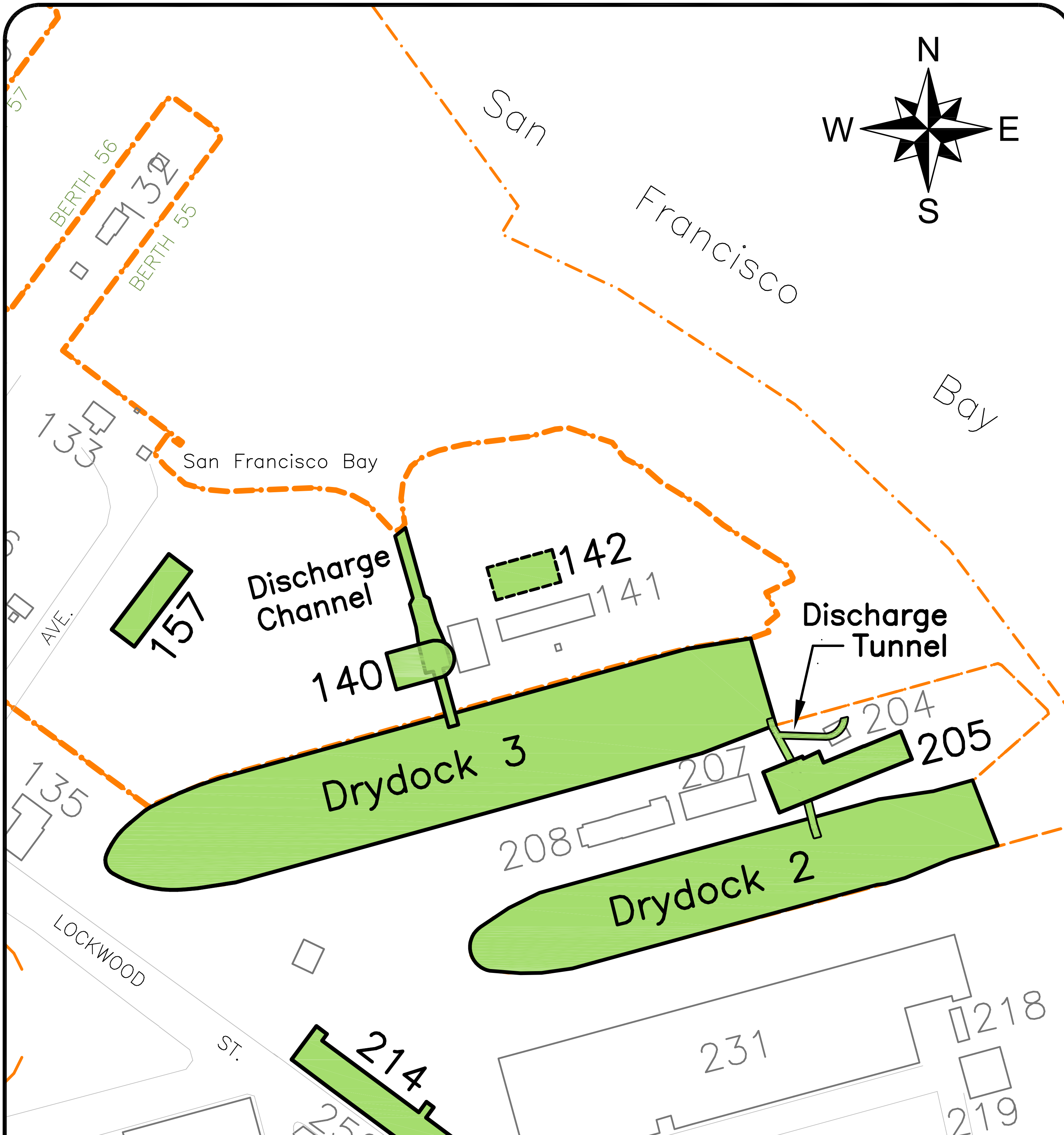
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Recommended Actions: Scoping Survey.



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200 0 200

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- Impacted Site with Designation (Demolished)
- Impacted IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary

All Berths shown are Impacted

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

Bldg. 140, 142 & Discharge Channel
Site Plan
January, 2004

Figure 8.3.2.6

8.3.2.7 Building 142

Site Description: Building 142 is a partially demolished concrete air raid shelter thought to be similar to Building 224. It is unclear from historical references whether this structure was above or below ground **(HRA-2963)**. A site plan is provided in Figure 8.3.2.6 above.

Former Uses: Air Raid Shelter A **(HRA-2963)**, weapons test sample storage, and high-level low background sample counting room **(HRA-405)**.

Current Uses: Unoccupied; partially demolished.

Radionuclides of Concern: Ra-226, Cs-137, Pu-239, and Sr-90.

Previous Radiological Investigations: None.

Contamination Potential: Unlikely.

Contaminated Media:

Surface Soil: Low
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Scoping Survey.

8.3.2.8 Building 146

Site Description: Building 146 is a wood-framed, shallow gabled roofed shop with windows throughout that was built in 1945. The building is two storied, sided in stucco on the first story and asbestos shingles on the second. Large sliding wooden doors provide access to the building. A site plan is provided in Figure 8.3.2.8, and a floor plan is provided in Figure 8.3.2.8FP.

Former Uses: Industrial and Photo Laboratory (1951-1964), General Shops, Radioactive Waste Storage Area, and Radioluminescent Device Turn-In Building **(HRA-2811, p 2; HRA-2829)**.

Current Uses: Unoccupied.

Radionuclides of Concern: Cs-137, Ra-226, and Sr-90.

Previous Radiological Investigations:

2002 NWT Phase V investigation. Class 3 survey complete.

1974 Shipyard closure survey. No activity detected.

Contamination Potential: Likely; building was radioluminescent device turn-in location.

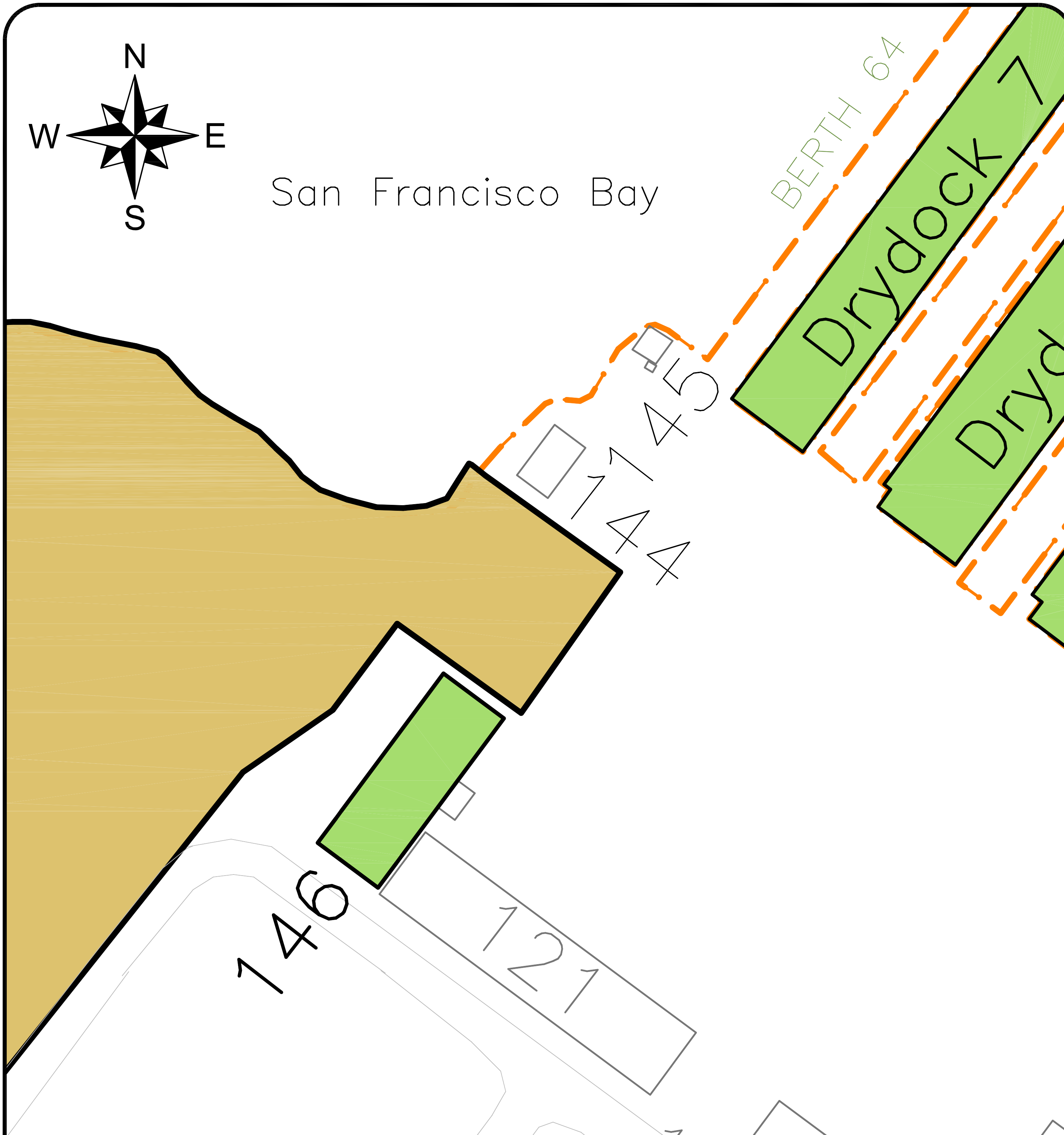
Contained Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Perform Characterization Survey.



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Scale in Feet

- Impacted Site with Designation
- Impacted Site with Designation (Demolished)
- Impacted IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary

All Berths shown are Impacted

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

Bldg. 146 Site Plan

January, 2004

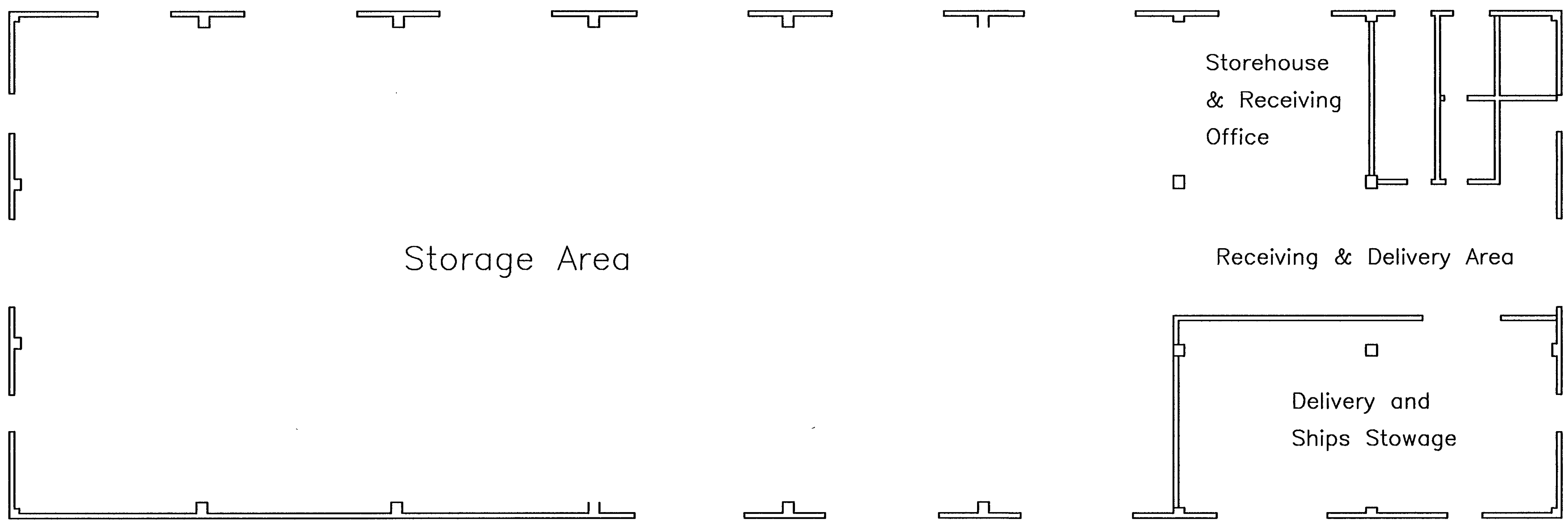
Figure 8.3.2.8

12 0 12

Scale in Feet

Notes:

Floorplan recreated from background image Map ID 167.



First Floor Plan

Hunters Point Naval Shipyard
San Francisco CA

Historical Radiological Assessment

May, 2003

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Figure 8.3.2.8 FP
Building 146 - Floor Plan

8.3.2.9 Building 157

Site Description: Building 157 is a corrugated metal, wood-framed structure approximately 40 feet by 140 feet in size. Specific historical descriptions of the building were not found. A site plan is provided in Figure 8.3.2.9.

Former Uses: Shipyard Industrial Laboratory, NDT, Sound Laboratory, Metals Testing Center (Radiography), and Metal Shop **(HRA-547)**.

Current Uses: Unoccupied.

Radionuclides of Concern: Co-60, Cs-137, and Ra-226.

Previous Radiological Investigations: None.

Contamination Potential: Unlikely.

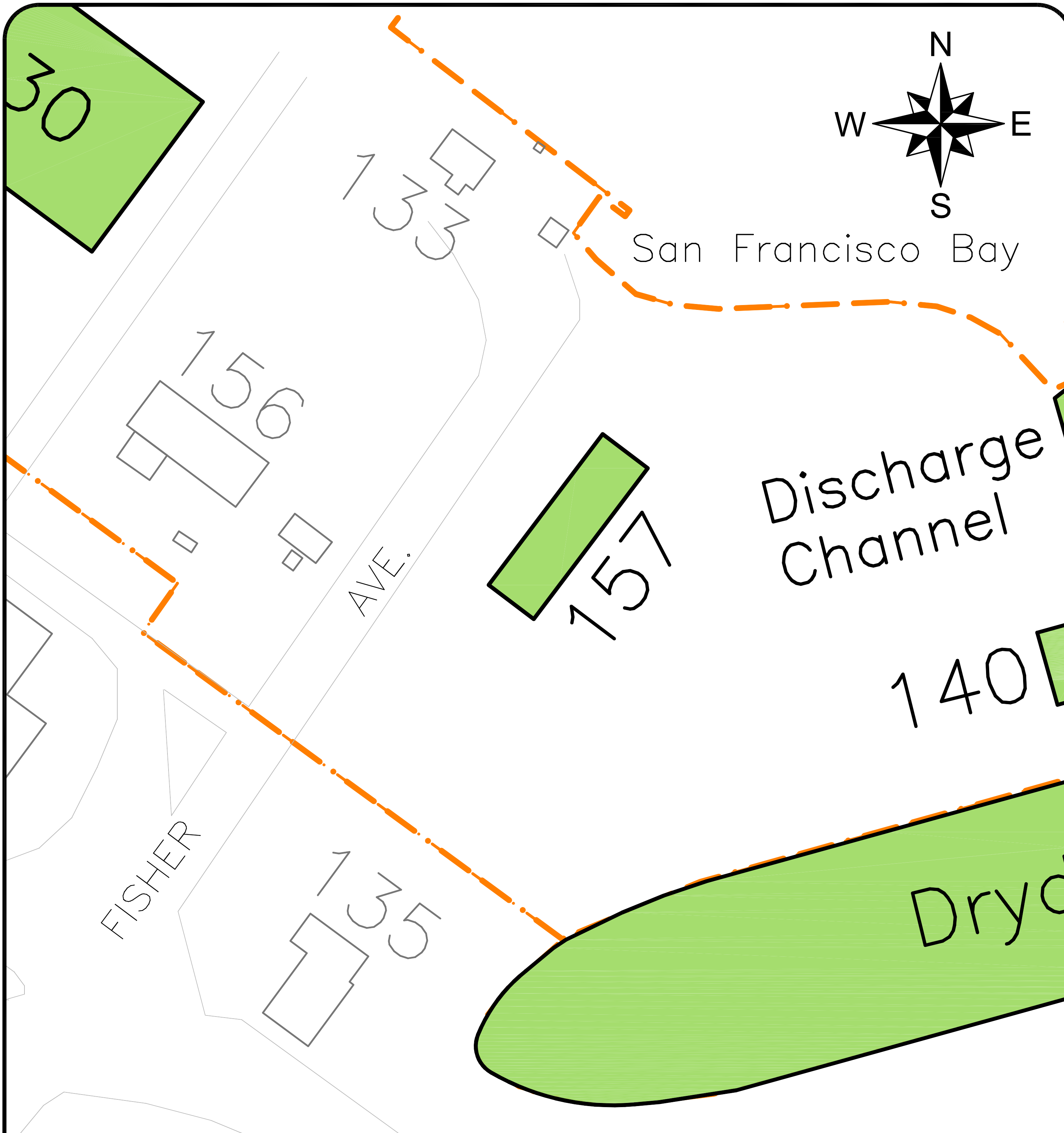
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Scoping Survey.



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100 0 100

Scale in Feet

- Impacted Site with Designation
- Impacted Site with Designation (Demolished)
- IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

Bldg. 157 Site Plan

January, 2004

Figure 8.3.2.9

8.3.2.10 Drydock 5

Site Description: Built in 1944, the chief function of Drydock 5 was submarine repair, but it was also capable of housing destroyers and other relatively small vessels. The drydock is 420 feet by 60 feet, with a gate that is hinged at the bottom that flaps down to allow the vessel to enter. The drydock was dewatered by four 20,000-gallons per minute (gpm) pumps. Two pumps were located at each side of the Bay end of the dock **(HRA-4683)**. A drydock site plan is provided in Figure 8.3.2.10.

Former Uses: Decontamination of ships from OPERATION CROSSROADS and Ship Repair (Submarines).

Current Uses: Unused.

Radionuclides of Concern: Cs-137, Sr-90, Pu-239, and Ra-226.

Previous Radiological Investigations: None.

Contamination Potential: Unlikely.

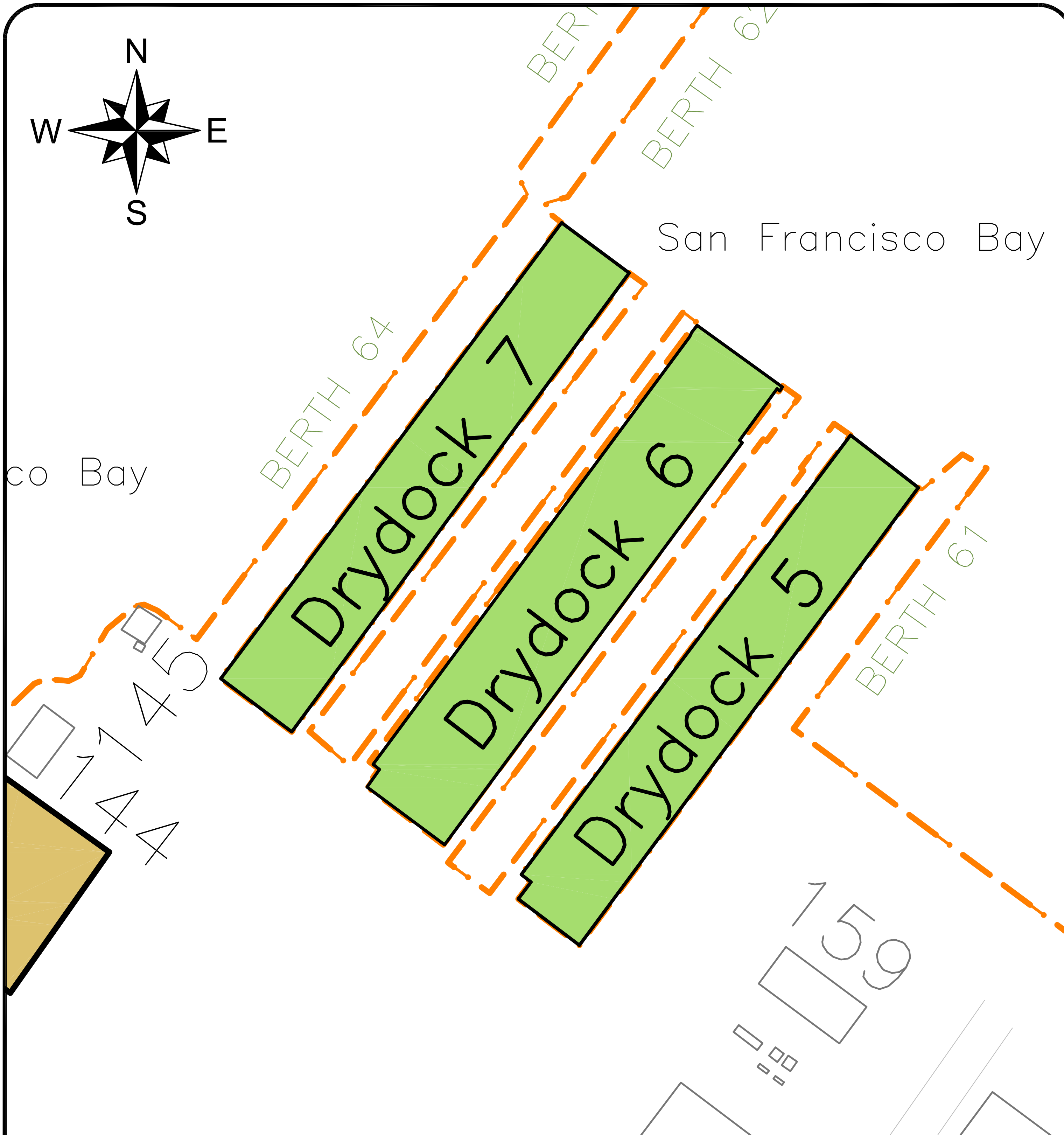
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Recommended Actions: Scoping Survey.



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100 0 100

Scale in Feet

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- Impacted Site with Designation (Demolished)
- Impacted IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary

All Berths shown are Impacted

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

Drydock 5, 6 & 7 Site Plan

January, 2004

Figure 8.3.2.10

8.3.2.11 Drydock 6

Site Description: Drydock 6 was built in 1944 for submarine repair, but was also capable of housing destroyers and other relatively small vessels. The drydock is 420 feet by 75 feet, with a gate that is hinged at the bottom that flaps down to allow the vessel to enter. The drydock was dewatered by four 20,000-gpm pumps. Two pumps were located at each side of the Bay end of the dock **(HRA-4683)**. A drydock site plan of is provided in Figure 8.3.2.10 above.

Former Uses: Decontamination Drydock for OPERATION CROSSROADS and Ship Repair (Submarines).

Current Uses: Unused.

Radionuclides of Concern: Cs-137, Sr-90, Pu-239, and Ra-226.

Previous Radiological Investigations:

2002 NWT Phase V investigation. Class 3 survey completed.

1947 HPS - Drydock 6; slight contamination on cap blocks, ships brow, securing lines, fire hose, and two electric cables.

Contamination Potential: Unlikely.

Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Recommended Actions: Review Final Status Survey Report.

8.3.2.12 Drydock 7

Site Description: Drydock 7 was built in 1944 for submarine repair, but was also capable of housing destroyers and other relatively small vessels. The drydock is 420 feet by 60 feet, with a gate that is hinged at the bottom that flaps down to allow the vessel to enter. The drydock was dewatered by four 20,000-gpm pumps. Two pumps were located at each side of the Bay end of the dock **(HRA-4683)**. A drydock site plan is provided in Figure 8.3.2.10 above.

Former Uses: Possible Decontamination Drydock for OPERATION CROSSROADS and Ship Repair (Submarines).

Current Uses: Unused.

Radionuclides of Concern: Cs-137, Pu-239, Ra-226, and Sr-90.

Previous Radiological Investigations: None.

Contamination Potential: Unlikely.

Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Recommended Actions: Scoping Survey.

8.3.2.13 IR-07

Site Description: IR-07 is a former disposal area with approximately two-thirds of the identified debris fill area located northeast of Building 916 and 25 feet below Donahue Street. IR-07 is approximately 700 feet by 700 feet in size. A site plan is provided in Figure 8.3.2.13.

Former Uses: Flat Land Area Built by the Navy Used to Support Conventional (Non-Nuclear) Submarine Maintenance. Potential Disposal of Waste from Decontamination of Ships from OPERATION CROSSROADS.

Current Uses: Undeveloped open land.

Radionuclides of Concern: Ra-226, Cs-137, Sr-90, and Pu-239 (OPERATION CROSSROADS decontamination activities).

Previous Radiological Investigations:

1999 IT Corporation sandblast media samples. No activity exceeding background levels.

1994 EPA soil samples. No detectable activity above background

1993 PRC, Phase II Radiological Investigation. No readings exceeding background.

1992 Phase I SCRS. General area gamma anomalies were noted in sandy soils, soil samples indicated Ra-226 and daughters and other naturally occurring radionuclides.

1988 HLA - conducted survey; results indicated background levels.

Contamination Potential: Unlikely.

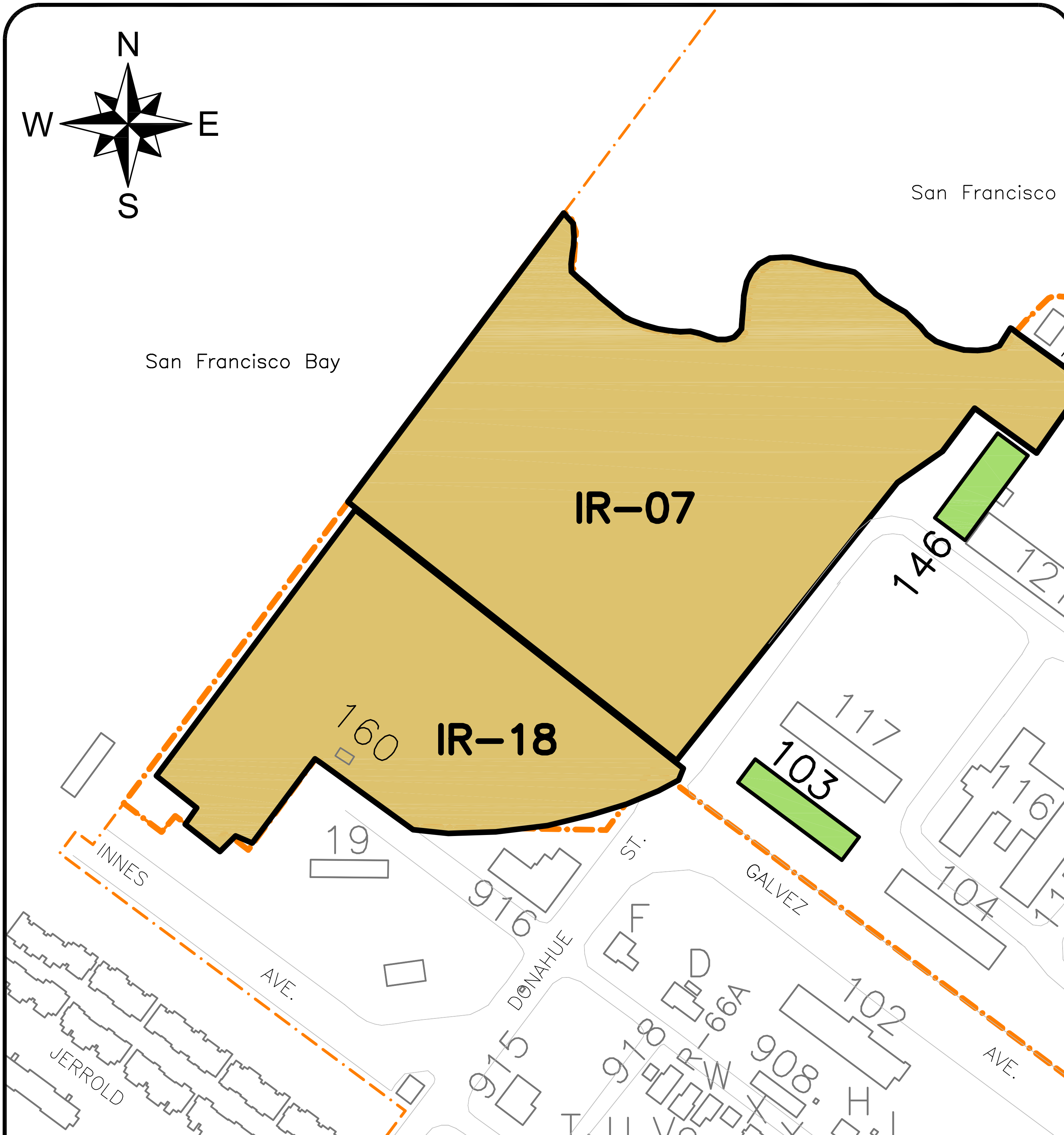
Contaminated Media:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Recommended Actions: Scoping Survey of unremediated areas.



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200 0 200
Scale in Feet

- Impacted Site with Designation
- Impacted Site with Designation (Demolished)
- Impacted IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

IR-07 & IR-18 Site Plan

January, 2004

Figure 8.3.2.13

8.3.2.14 IR-18

Site Description: IR-18 is a former fill area approximately one-third of which is located northeast of Building 916 and 25 feet below Donahue Street. IR-18 is approximately 500 feet by 500 feet in size. A site plan is provided in Figure 8.3.2.13 above.

Former Uses: Flat Land Area Built by the Navy. Waste Oil Disposal Area **(HRA-2991),** Potentially Used for Disposal of OPERATION CROSSROADS Decontamination Materials, and Recreational Vehicle Camping/Parking.

Current Uses: Undeveloped open land.

Radionuclides of Concern: Ra-226, Cs-137, Sr-90, Pu-239 (OPERATION CROSSROADS sandblast spoils).

Previous Radiological Investigations:

1994 EPA soil samples. No detectable activity above background. EPA attributed activity to naturally occurring granitic materials.

1992 Phase I SCRS. General area gamma anomalies were noted in sandy soils; soil samples indicated Ra-226 and daughters and other naturally occurring radionuclides.

1992 PRC radon flux testing – No levels exceeding background levels.

Contamination Potential: Unlikely.

Contaminated Media:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Recommended Actions: Scoping Survey of unremediated areas.

8.3.3 Parcel C Impacted Sites

8.3.3.1 Building 203

Site Description: Building 203 is a large reinforced concrete building housing a power plant **(HRA-2963)**. Constructed in 1943and extended in 1945, the building measures 152 feet by 137 feet **(HRA-1118, p 58)**. The building is also referred to as Substation H **(HRA-4667)**. It has a flat reinforced concrete roof with a slight overhang. The building includes a major addition that is sided in corrugated metal (likely the 1945 extension). A building site plan is provided in Figure 8.3.3.1, and a floor plan is provided in Figure 8.3.3.1FP.

Former Uses: Power Plant **(HRA-1118, p 58; HRA-2963; HRA-4667)**. This is one of two sites suspected of burning of fuel oil from three OPERATION CROSSROADS target ships.

Current Uses: Unoccupied.

Radionuclides of Concern: Cs-137, Sr-90, Pu-239, and Ra-226.

Previous Radiological Investigations: None.

Contamination Potential: Unlikely.

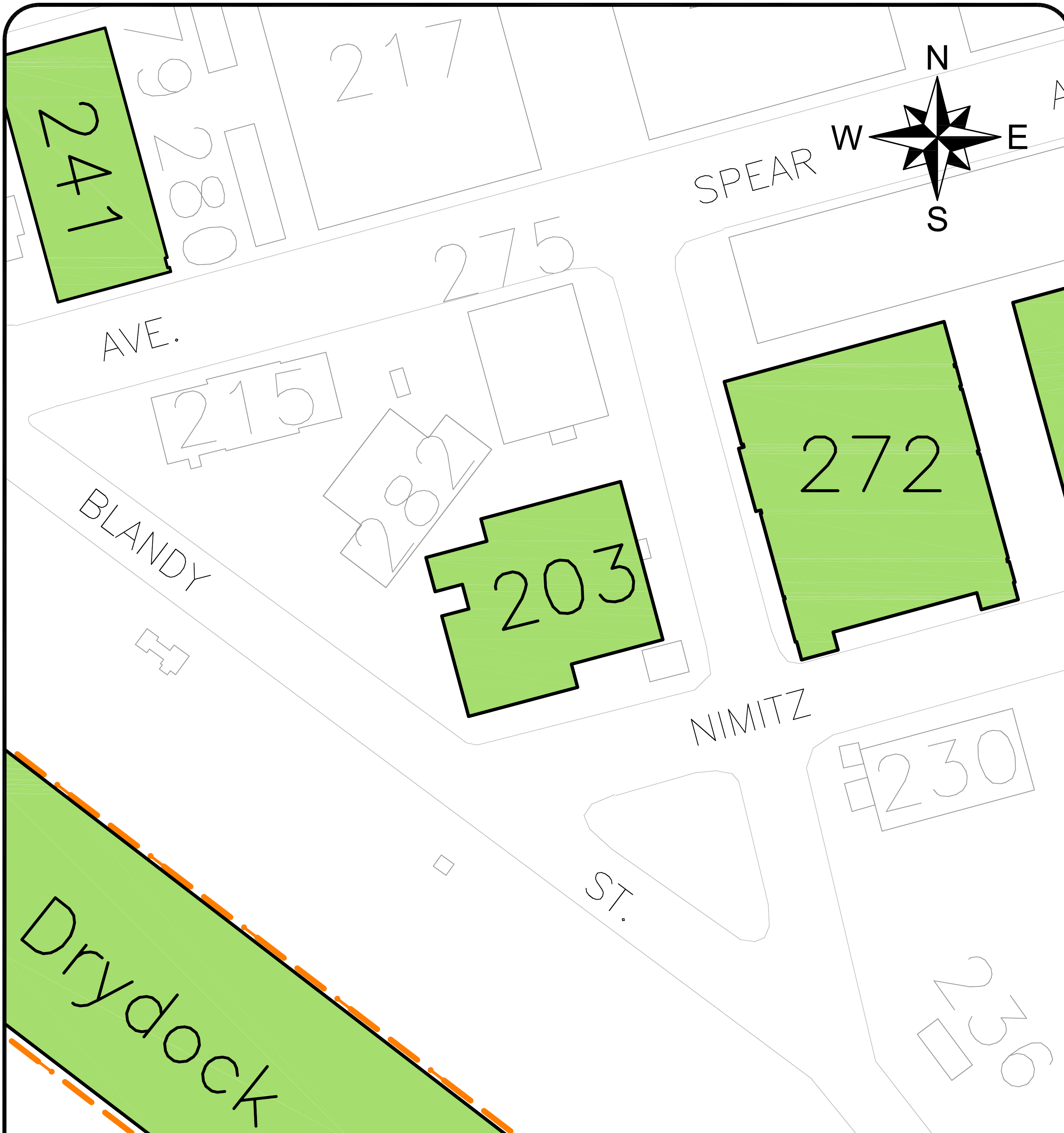
Contaminated Media:

Surface Soil: Low
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Scoping Survey.



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- IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary

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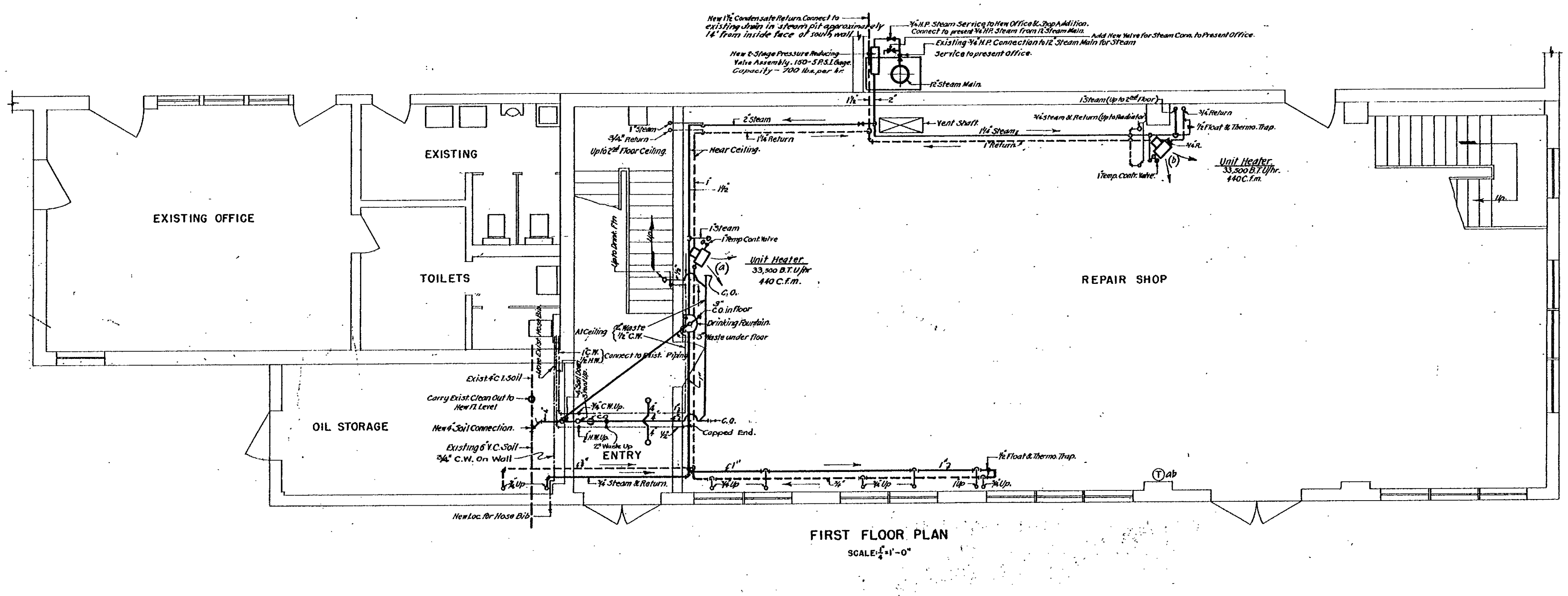
San Francisco CA
Historical Radiological Assessment

Bldg. 203 Site Plan

January, 2004

Figure 8.3.3.1



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Scale in Feet

Notes:

Background image per Map ID 143.

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Figure 8.3.3.1 FP
Building 203 - Floor Plan

8.3.3.2 Building 205 and Discharge Channel

Site Description: Building 205 is a single-story L-shaped brick building, measuring 211 by 61 feet. Two WW II era additions were made to the rear of the original building. The building houses the pumping machinery for Drydock 2 **(HRA-1119, p 54; HRA-4667)**. A discharge tunnel connects the building to the drydock. There is also a channel connecting the building to Drydock 3 **(HRA-4686)**. A site plan is provided in Figure 8.3.3.2.

Former Uses: Pumphouse for Drydock 2.

Current Uses: Unoccupied.

Radionuclides of Concern: Cs-137, Pu-239, and Ra-226.

Previous Radiological Investigations: None.

Contamination Potential: Unlikely.

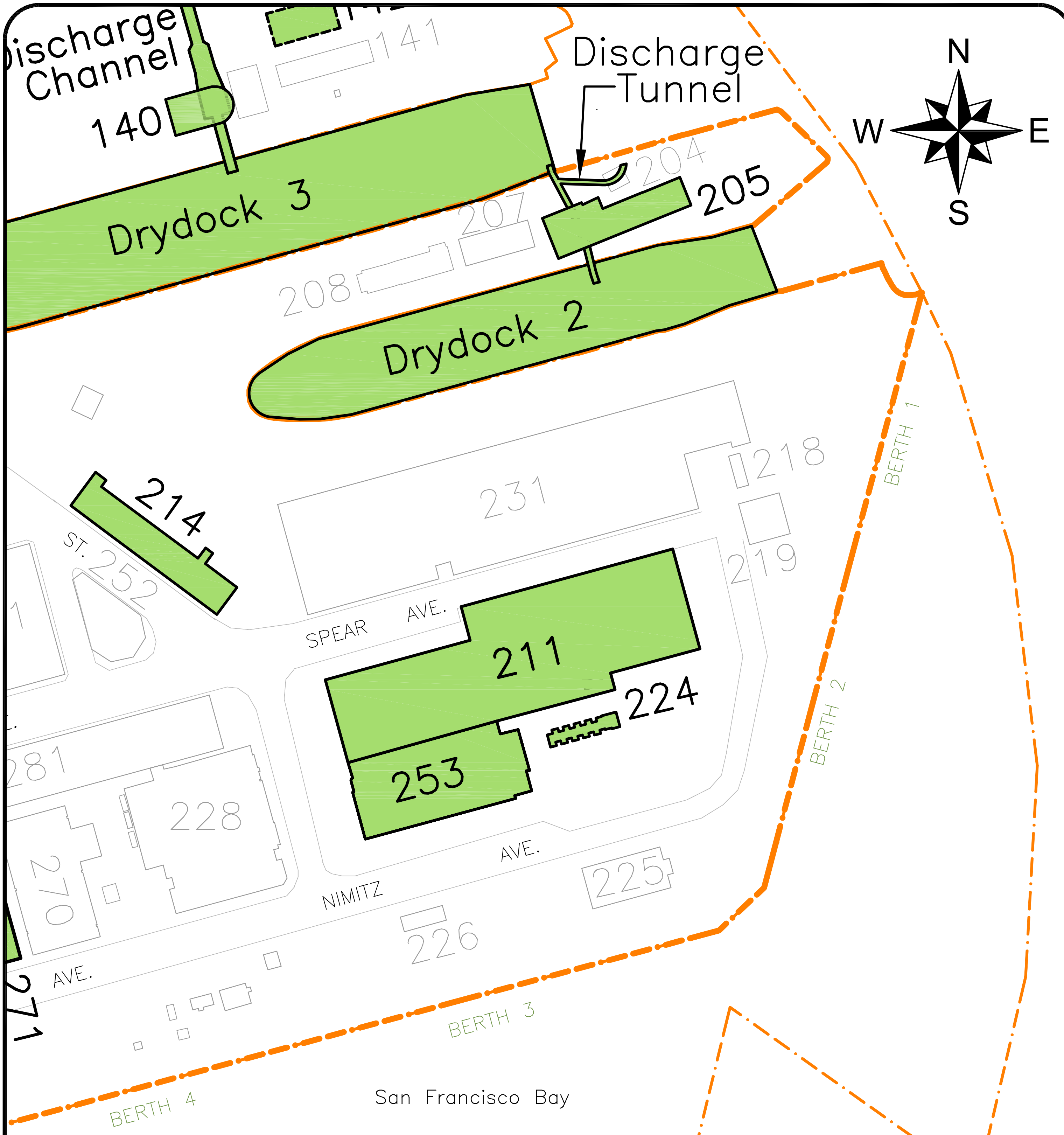
Contained Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Recommended Actions: Scoping Survey.



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- Impacted IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary

All Berths shown are Impacted

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

Bldg. 205, 211, 214, 224, 253
Site Plan
January, 2004

Figure 8.3.3.2

8.3.3.3 Building 211

Site Description: Building 211 is a three-story concrete-framed, curtain-walled building that was built in 1942 **(HRA-1118, p 92)**. It is a large warehouse-type building, with a large gantry for craning materials to the upper stories. Building 211 is attached to Building 253 **(HRA-1118, p 94)**. A building site plan is provided in Figure 8.3.3.2 above.

Former Uses: Machinery and Electrical Test/Repair Shop **(HRA-2963; HRA-4667)** and Contractor LLRW Storage Site.

Current Uses: Unoccupied.

Radionuclides of Concern: Cs-137, Ra-226, and Th-232.

Previous Radiological Investigations: NWT Phase V investigation. There is a small area of Th-232 contamination on the concrete floor.

Contamination Potential: Known-Continued Access: Th-232 from refractory compound and welding electrodes.

Contained Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Moderate
Drainage Systems: Low (common drains with Building 253)

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low (common drains with Building 253)

Recommended Actions: Remediate area of Th-232 contamination. Final Status Survey following remediation.

8.3.3.4 Building 214

Site Description: Building 214 is of typical wooden WW II era administration building design, built from standardized Bureau of Yards and Docks plans **(HRA-1118, p 108)**. A building site plan is provided in Figure 8.3.3.2 above.

Former Uses: Combat Weapons Systems Office **(HRA-4667)**, Administrative Offices **(HRA-2963)**, Accounting and Bond Office, Triple A Office Space, and NRDL Health Physics Counting Room in Room 105 **(HRA-3052 Encl 3)**.

Current Uses: Unoccupied.

Radionuclides of Concern: Cs-137, Pu-239, Ra-226, and Sr-90.

Previous Radiological Investigations:

2002 NWT Phase V investigation. Surveys completed.

1996 PRC – survey found no detectable activity in building.

1974 Shipyard closure survey. No detectable activity.

Contamination Potential: Unlikely.

Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Review Final Status Survey Report.

8.3.3.5 Building 224

Site Description: Building 224 is a reinforced concrete bomb shelter (in foreground) that was built in the main industrial area of HPS in 1944. The building is mostly underground, rising only 3 feet out of the ground **(HRA-1118, p 86)**. Metal doors and stairwells lead to a series of small rooms. A building site plan is provided in Figure 8.3.3.2 above.

Former Uses: Air Raid Shelter and OPERATIONS CROSSROADS and GREENHOUSE Sample Storage **(HRA-405; HRA-4667)**.

Current Uses: Unoccupied.

Radionuclides of Concern: Cs-137, Pu-239, and Sr-90.

Previous Radiological Investigations:

2002 NWT Phase V investigation. Survey complete. One sample from cell showed Cs-137 levels slightly exceeding the release criteria. Currently under review.

Contamination Potential: Likely.

Contained Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Review Final Status Survey Report.

8.3.3.6 Building 241

Site Description: Building 241 is a large wood-framed, monitored (lights and ventilation) shop building, including a shallow, almost flat, gabled roof with monitors and shallow shed-roofed forms at either side. A building site plan is provided in Figure 8.3.3.6.

Former Uses: Forge Shop **(HRA-2963)**.

Current Uses: Unoccupied.

Radionuclides of Concern: Naturally occurring thorium from firebrick and known use of potassium nitrate.

Previous Radiological Investigations: 2002 NWT Phase V investigation. Survey completed. Potassium nitrate and firebrick removed and disposed of off site.

Contamination Potential: Unlikely.

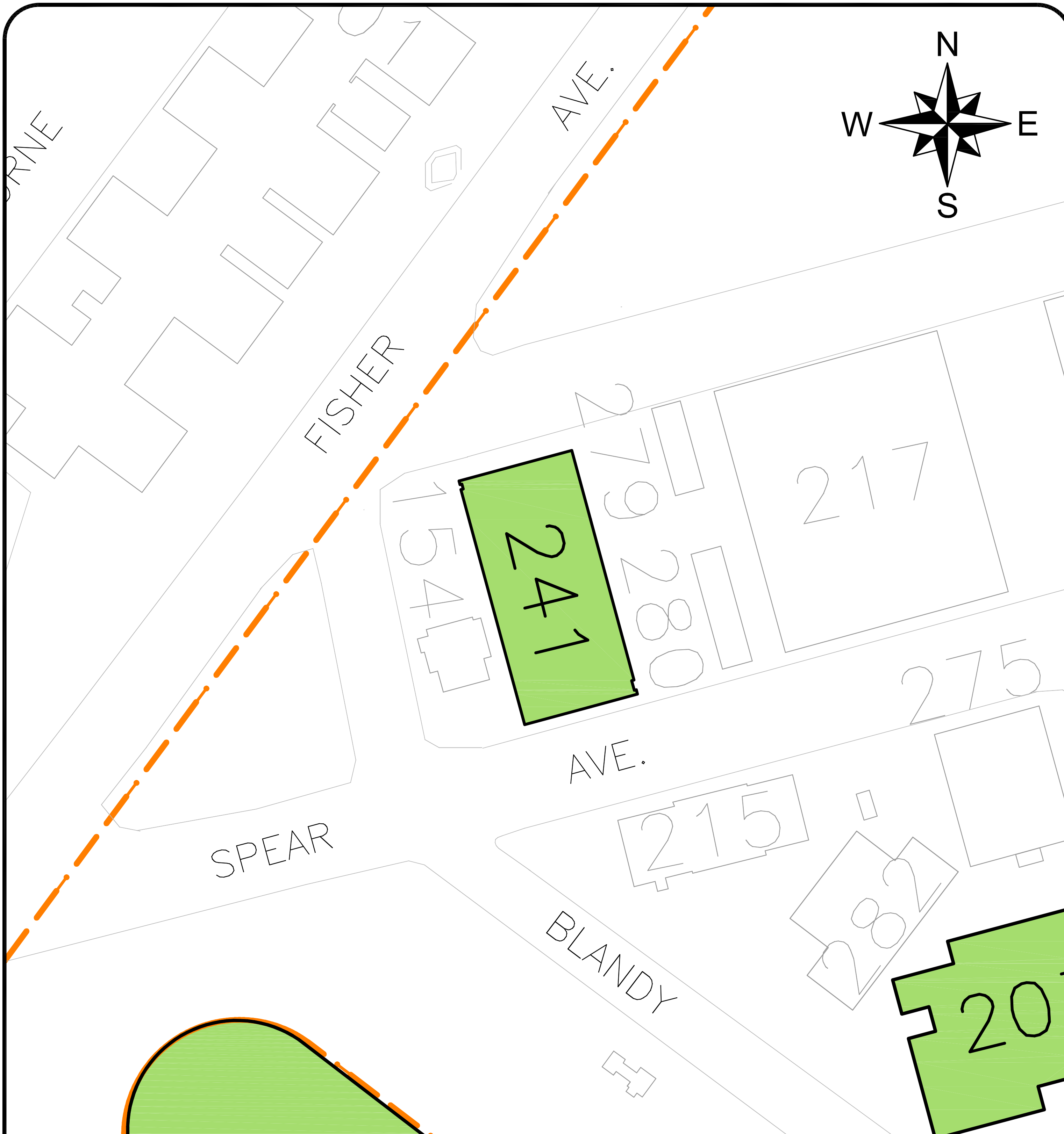
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Review Final Status Survey Report.



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- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

Bldg. 241 Site Plan

January, 2004

Figure 8.3.3.6

8.3.3.7 Building 253

Site Description: Building 253 is a six-story concrete-framed, glass curtain-walled building built between 1944 and 1947. The building has a large gantry for the craning of equipment to the upper stories and a periscope tower extending vertically from the roof. Building 253 is attached to Building 211 **(HRA-1118, pp 94-96)**. The glazing for Building 253 is standard glass. A building site plan is provided in Figure 8.3.3.2 above, and a floor plan is provided in Figure 8.3.3.7FP.

Former Uses: Radiography Instrument Calibration through 1974 **(HRA-601, p 9)**; Gauge Shop **(HRA-601, p 10)**; Electronics, Optical, and Ordnance Shops **(HRA-2963)**; Weapons Shop **(HRA-372, p 14)**; Electrical Shop **(HRA-372, p 17)**; Equipment from OPERATION CROSSROADS Ships; Maritime Administration Ship Parts Storage (1994); and Probable Location of Radium Paint Activities (Gauge Shop).

Current Uses: Unoccupied.

Radionuclides of Concern: Cs-137, Pu-239, Ra-226, Sr-90, and Th-232.

Previous Radiological Investigations:

2003 NWT partial building characterization survey.

2002 NWT Phase V investigation. Extensive low-level contamination (Cs-137 and Ra-226) found in and on the building and in the building ventilation system. Remediation completed on roof.

1974 Shipyard closure survey of sixth floor. No detectable activity based on limits for the period.

Contamination Potential: Known-Continued Access.

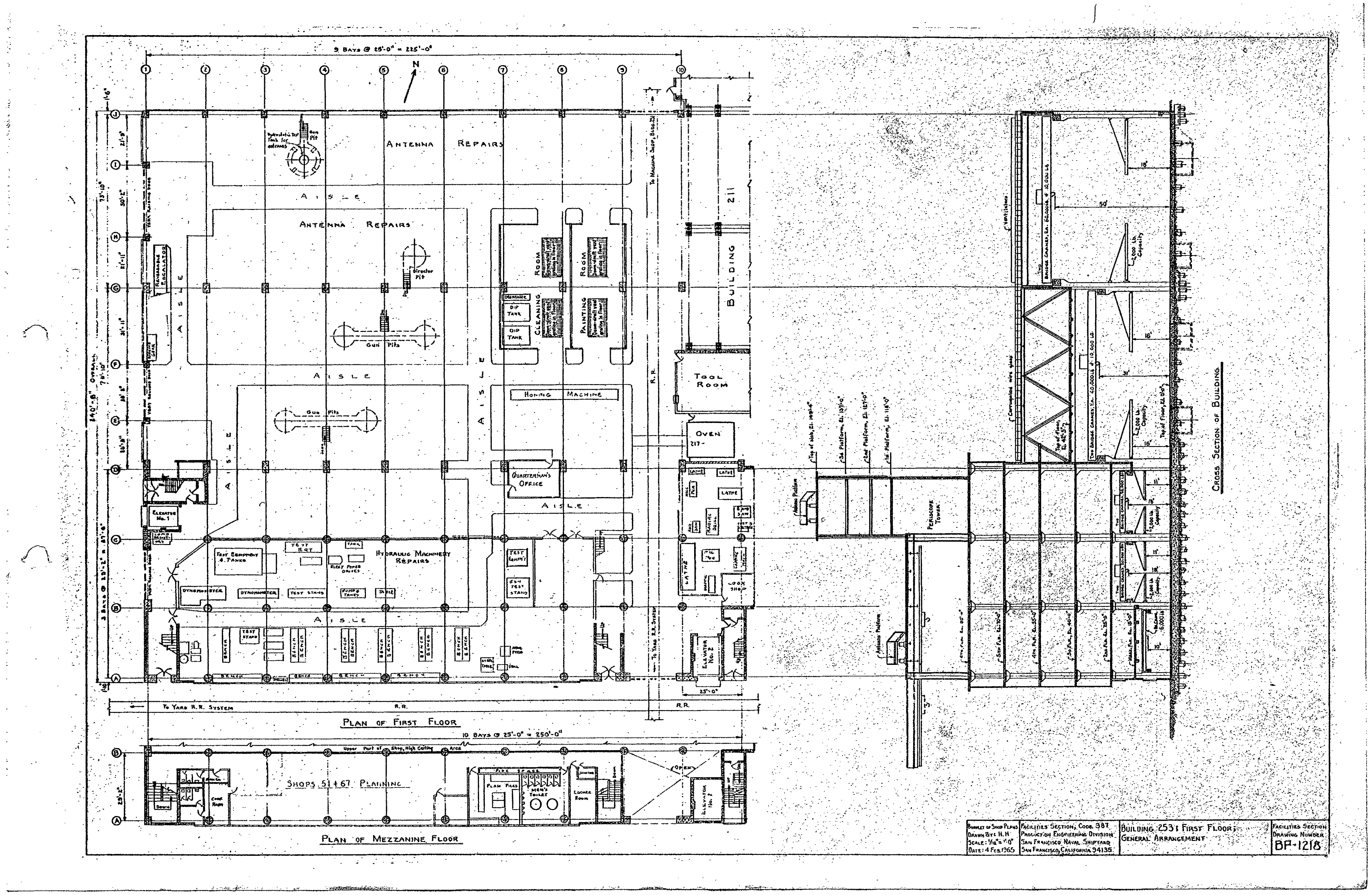
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: High
Drainage Systems: High

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Moderate
Drainage Systems: Moderate

Recommended Actions: Complete Characterization Survey and Remediate Contamination.



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Scale in Feet

Notes:

Background image per Map ID 527.

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Figure 8.3.3.7FP
Building 253 - Floor Plan

8.3.3.8 Building 271

Site Description: Building 271 is a single width, metal-sided shop building that was built in 1947 and manufactured by the Butler Company or in the manner of Butler Company buildings. This prefabricated, standard building was used on military bases due to limited budgets **(HRA-1118, p 106)**. A building site plan is provided in Figure 8.3.3.8.

Former Uses: Spray Painting **(HRA-171, p 16)**, Paint Shop Annex **(HRA-2963)**, and Equipment Storage/Barge Services Office (Supervisor of Shipbuilding, Conversion, and Repair [SUPSHIP]) (1994).

Current Uses: Unoccupied.

Radionuclides of Concern: Ra-226.

Previous Radiological Investigations:

2002 NWT Phase V investigation. Ra-226 contamination found. Remediation and disposal completed. Resurvey complete.

Contamination Potential: Unlikely.

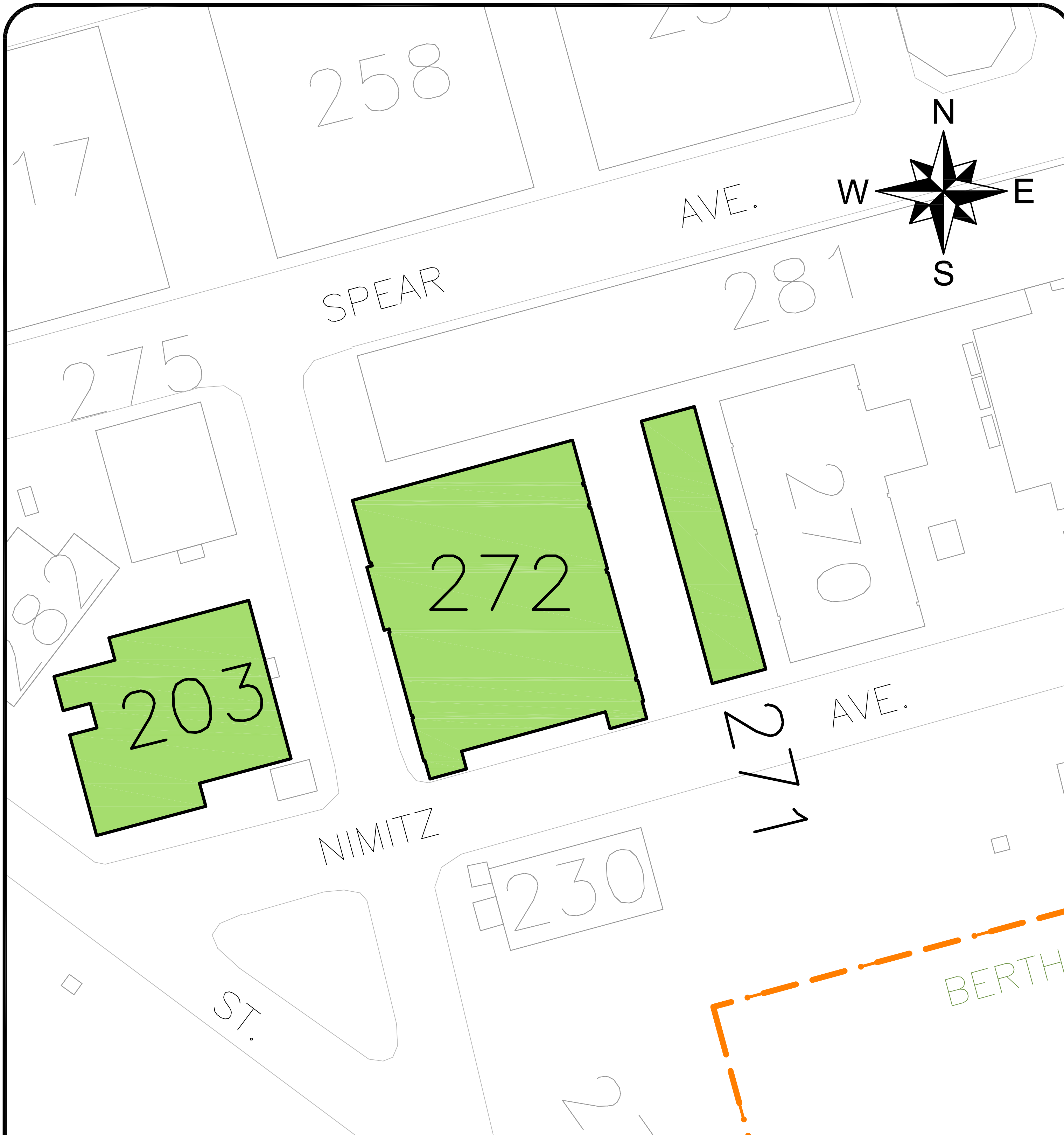
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Review Final Status Survey Report.



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- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

Bldg. 271 & 272 Site Plan

January, 2004

Figure 8.3.3.8

8.3.3.9 Building 272

Site Description: Building 272 is a large wood-framed shop building that includes a shallow, almost flat, gabled roof with monitors and with shallow shed-roofed forms at either side. A building site plan is provided in Figure 8.3.3.8 above.

Former Uses: Machine Shop **(HRA-1118, p 139)**; Manufacture and Repair of Machine Tools **(HRA-372, p 10)**; Paint Shop Service Group Offices **(HRA-4667)**; Riggers Tooling Storage and Issue, Riggers, and Laborers Shop **(HRA-20, p 2-50-3)**; and Possible Radiography.

Current Uses: Unoccupied.

Radionuclides of Concern: Co-60, Cs-137, and Ra-226.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Survey complete.

Contamination Potential: Unlikely.

Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Review Final Status Survey Report.

8.3.3.10 Drydock 2

Site Description: Drydock 2 is a graving drydock, measuring 750 feet by122 feet at ground level and 712 feet by 74 feet at the bottom. It is approximately 30 feet deep **(HRA-1117, p 149)**. The drydock was filled through 13 30-inch culverts in the steel caisson. A discharge channel runs east from the drydock to the Bay **(HRA-4749)**. A drydock site plan is provided in Figure 8.3.3.10.

Former Uses: Drydock, OPERATION CROSSROADS Ship Decontamination, Decontamination of YAG-39 and YAG-40, and Possible Removal of Radium Devices from Ships.

Current Uses: Unused.

Radionuclides of Concern: Cs-137, Pu-239, Ra-226, and Sr-90.

Previous Radiological Investigations:

2002 NWT Phase V investigation. Seven radium-bearing devices found and removed from the wall of the drydock. Surveys completed.

Contamination Potential: Likely.

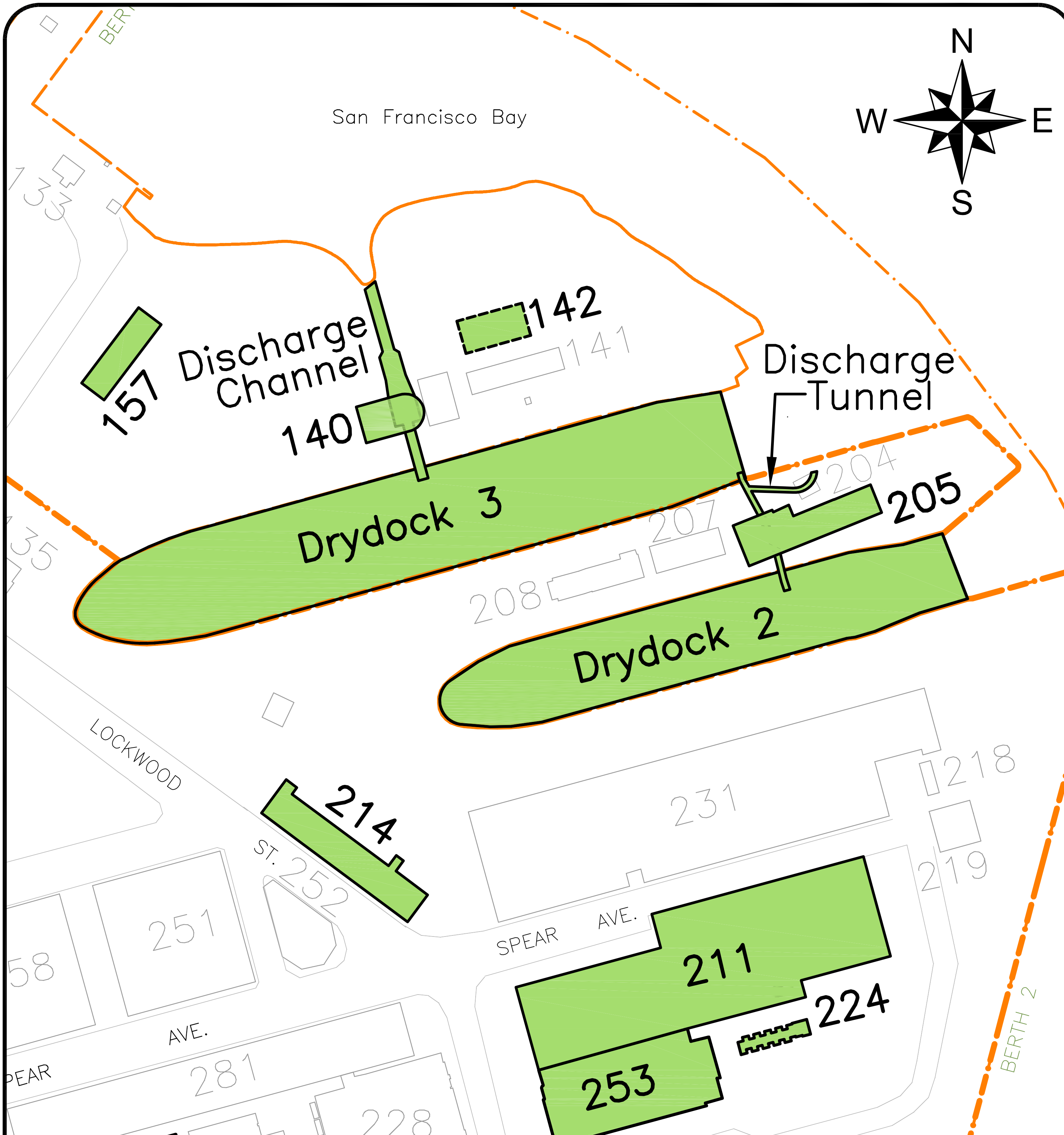
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Moderate
Drainage Systems: Low

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Recommended Actions: Review Final Status Survey Report.



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200 0 200
Scale in Feet

Impacted Site with Designation
Impacted Site with Designation (Demolished)
IR Site w/ Designation
Non - Impacted Building
Non-Impacted Building (Demolished)
Topographic Feature
Parcel Boundary
All Berths shown are Impacted

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San Francisco CA
Historical Radiological Assessment

Drydock 2 & 3 Site Plan

January, 2004

Figure 8.3.3.10

8.3.3.11 Drydock 3

Site Description: Drydock 3 is a graving drydock that is located north of and parallel to Drydock 2. It measures 1,076 feet by 153 feet at ground level and 1,020 feet by 110 feet at the bottom. This drydock used granite blocks at the gate area; however, the gates have been removed **(HRA-1117, p 139)**. A channel for water from Drydock 3 passes in a straight line north from the drydock through Pumphouse 3 (Building 140) to the Bay **(HRA-4689)**. A drydock site plan is provided in Figure 8.3.3.10 above.

Former Uses: Drydock, OPERATION CROSSROADS Ship Decontamination, Possible Removal of Radium Devices from Ships, and Triple A.

Current Uses: Unused.

Radionuclides of Concern: Cs-137, Pu-239, Ra-226, and Sr-90.

Previous Radiological Investigations:

2002 NWT Phase V investigation. Three radium-bearing devices found and removed. Resurvey completed.

1947 Surveys during CROSSROADS decontamination activities; background with instruments of the period **(HRA-506)**.

Contamination Potential: Likely.

Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Moderate
Drainage Systems: Low

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Recommended Actions: Review Final Status Survey Report.

8.3.3.12 Drydock 4

Site Description: Drydock 4 is a 1,092-by-143 foot, 53-foot-deep concrete graving drydock, with a rounded northwest end. Access steps are recessed into the wall, and the floor is flat, while the walls are slightly sloping. The drydock is outlined by a crane track that permits access to ships in the dock from all angles. Two or more smaller ships could be docked for servicing at the same time **(HRA-1117, pp 157-160)**. A drainage system from the southeast corner of the drydock runs eastward to the Bay **(HRA-4691)**. A drydock site plan is provided in Figure 8.3.3.12.

Former Uses: Drydock, OPERATION CROSSROADS Ship Decontamination, and Possible Removal of Radium Devices from Ships.

Current Uses: Unused.

Radionuclides of Concern: Cs-137, Pu-239, Ra-226, and Sr-90.

Previous Radiological Investigations:

2002 NWT Phase V investigation. Radium-bearing devices found and removed. Resurvey completed.

1994 MINS survey. Concluded no impact from NNPP operations. Survey and sample methodology would identify radionuclides other that those resulting from NNPP operations.

1992 PRC Phase I cursory survey. No anomalies found.

1986 EPA survey. No anomalies found.

1947 Surveys during CROSSROADS decontamination activities at Drydock 4: waterway station 790 (northeast side) 0.007 rep beta/gamma, waterway station 765 (northeast side) 0.005 rep beta/gamma, and remainder were background **(HRA-506)**.

Contamination Potential: Likely.

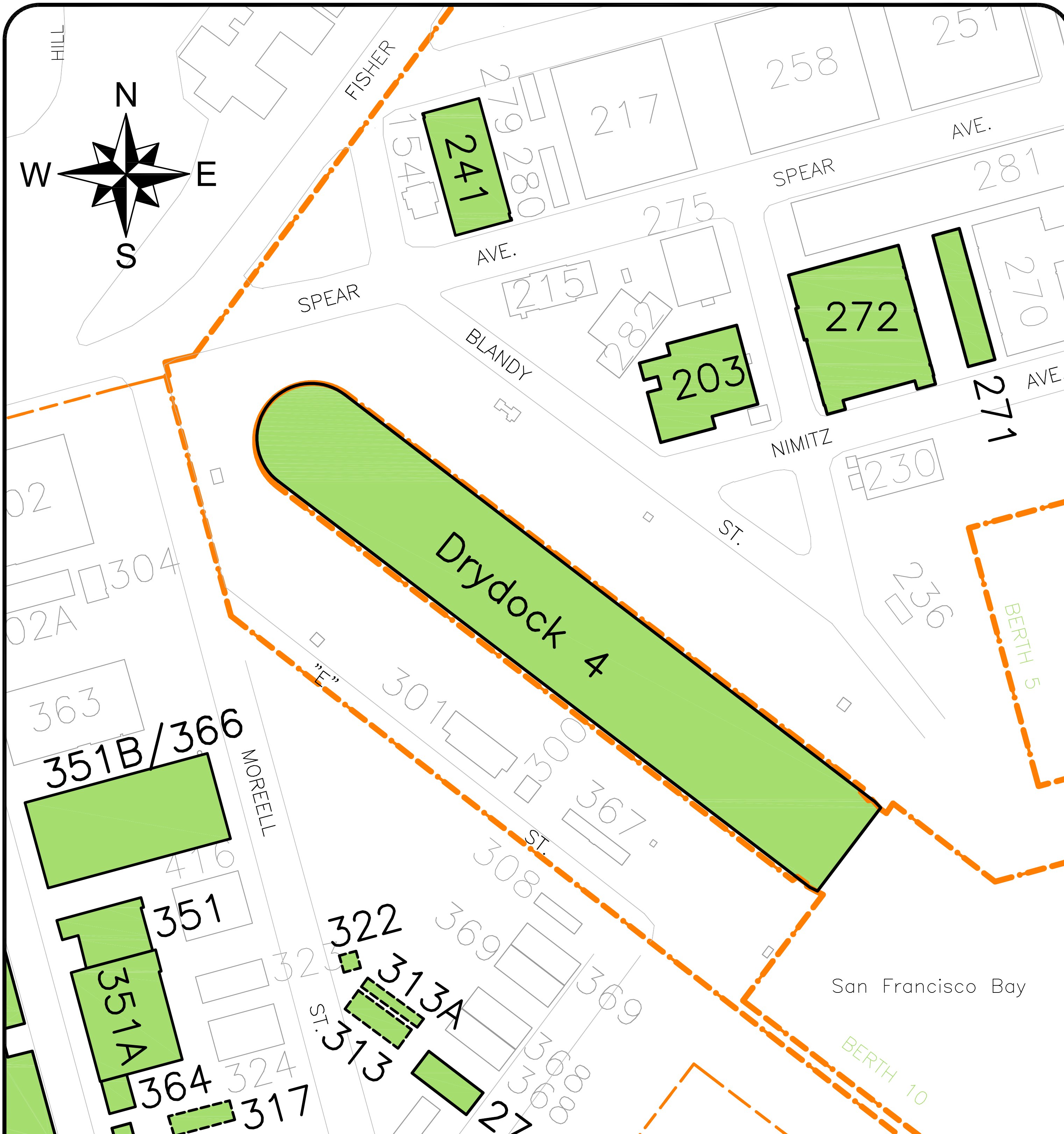
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Moderate
Drainage Systems: Low

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Recommended Actions: Review Final Status Survey Report.



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200 0 200

Scale in Feet

- Impacted Site with Designation
- Impacted Site with Designation (Demolished)
- IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

Drydock 4 Site Plan

January, 2004

Figure 8.3.3.12

8.3.4 Parcel D Impacted Sites

8.3.4.1 Building 274

Site Description: Building 274 is a shallow gable-roofed, corrugated, metal-sided shop building, measuring 100 feet by 40 feet. A building site plan is provided in Figure 8.3.4.1.

Former Uses: Decontamination Training **(HRA-174; HRA-333 p 3; HRA-4667)** and Office Space **(HRA-1118 p 48)**.

Current Uses: Unoccupied.

Radionuclides of Concern: Cs-137, Ra-226, and Sr-90.

Previous Radiological Investigations:

2002 NWT Phase V investigation. Survey completed.

1996 PRC – Determined that no survey was required, as only very short-lived radionuclides were used.

Contamination Potential: Unlikely.

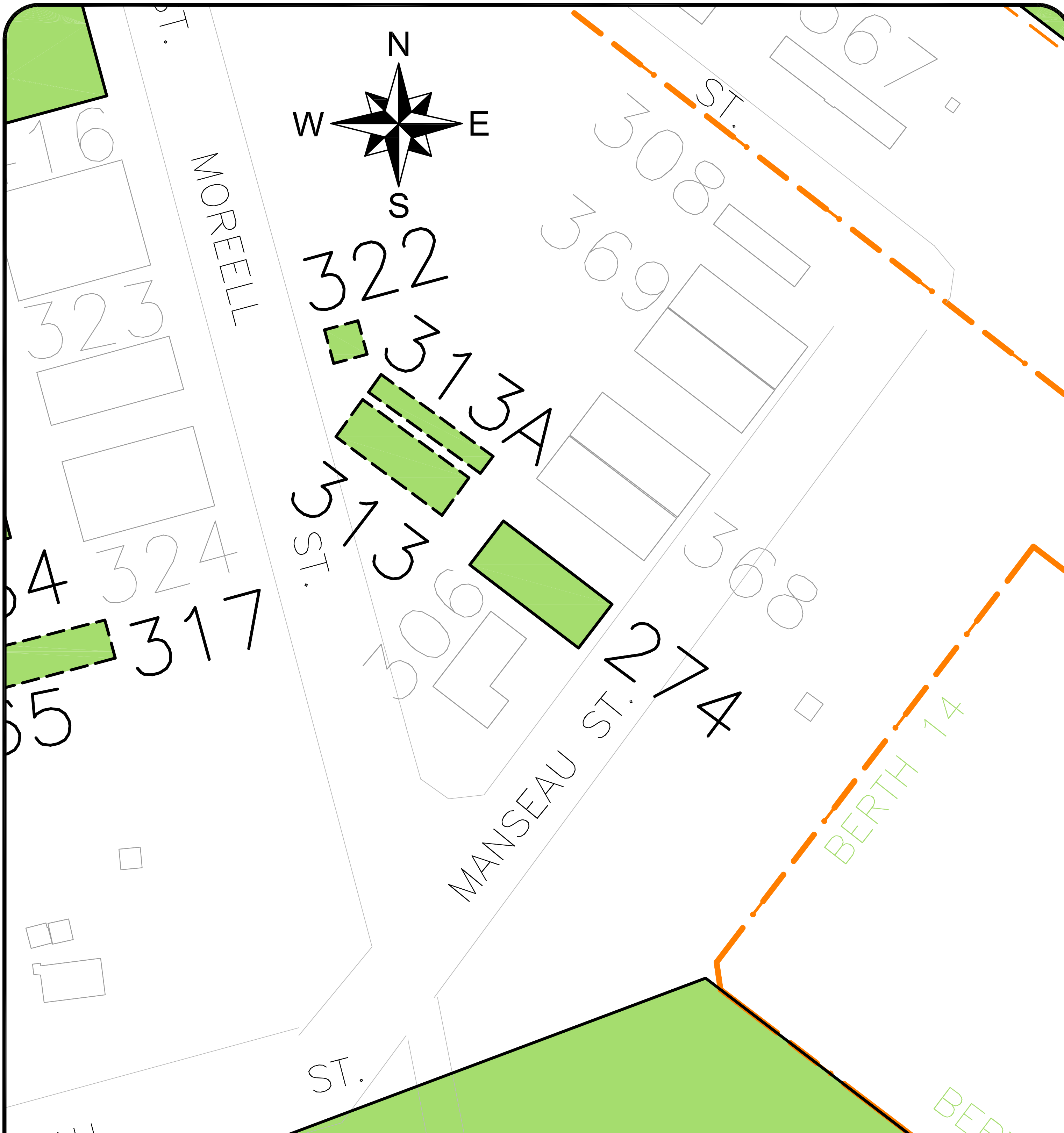
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Review Final Status Survey Report.



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- IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

Bldg. 274, 306, 313, 313A, 322
Site Plan
January, 2004

Figure 8.3.4.1

8.3.4.2 Building 313 Site

Site Description: Building 313 was formerly a temporary wooden building, measuring approximately 3,600 square feet **(HRA-1327 Encl 1, p 1)**. It was adjacent to Building 313A. A building site plan is provided in Figure 8.3.4.1 above.

Former Uses: NRDL Instrumentation Laboratory and Stockroom **(HRA-2963)** and Storage **(HRA-274).**

Current Use: Demolished.

Radionuclides of Concern: Cs-137, Pu-239, Ra-226, Sr-90, and Th-232.

Previous Radiological Investigations:

2002 NWT Phase V investigation. Cs-137 found above action levels. Area remediated. Resurvey complete.

1955 NRDL survey for contamination. Below release limits of the period.

Contamination Potential: Likely.

Contaminated Media:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Recommended Actions: Review Final Status Survey Report.

8.3.4.3 Building 313A Site

Site Description: Building 313A formerly measured approximately 750 square feet and was described as a small Homoja building **(HRA-1327 Encl 1, p1)**. The building was adjacent to Building 313. A building site plan is provided in Figure 8.3.4.1 above.

Former Uses: Laboratory Offices, Training **(HRA-1327 Encl 1, p 1)**, and Storage **(HRA-274)**.

Current Uses: Demolished.

Radionuclides of Concern: Cs-137, Pu-239, Ra-226, Sr-90, and Th-232.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Investigation due to discovery of manhole with Cs-137 above release limits in sediment completed; no connecting lines. Manhole removed. Final Status Survey complete.

1955 Surveyed. Cleared below release limits by NRDL.

Contamination Potential: Likely.

Contaminated Media:

Surface Soil: Moderate
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: Moderate

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: Low

Recommended Actions: Review Final Status Survey Report.

8.3.4.4 Building 317 Site

Site Description: Building 317 originally measured approximately 100 feet by 30 feet and was located behind Buildings 364 and 365. A site plan is provided in Figure 8.3.4.4.

Former Uses: Temporary Animal Quarters for NRDL **(HRA-1752 Encl 3, p 2)**.

Current Uses: Demolished.

Radionuclides of Concern: Cs-137, Ra-226, and Sr-90.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Survey complete. Cs-137 found exceeding release criteria. Remediated and resurveyed.

Contamination Potential: Likely.

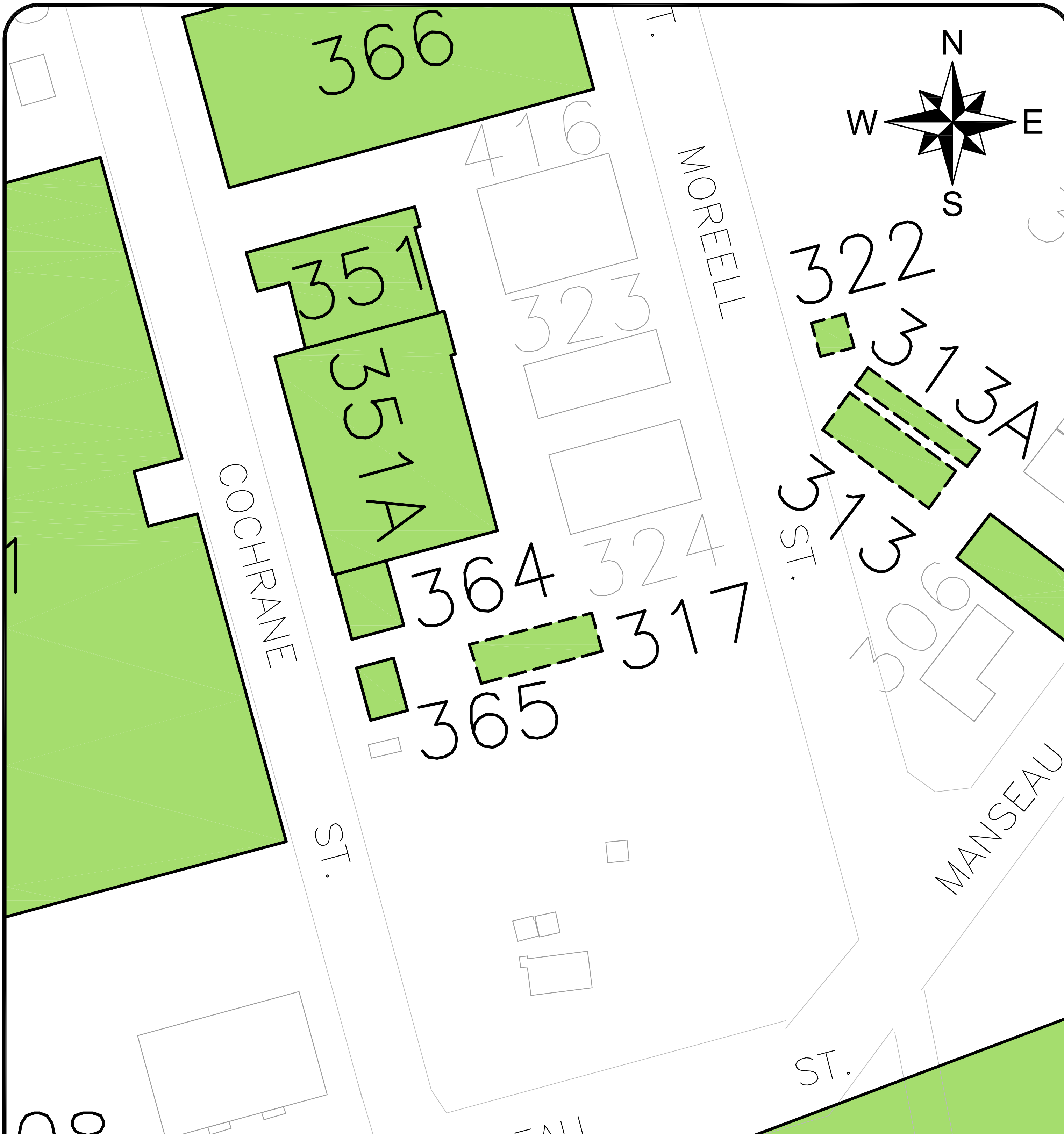
Contaminated Media:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Recommended Actions: Review Final Status Survey Report.



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- Impacted Site with Designation (Demolished)
- IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

Bldg. 317, 351, 351A, 364, 365
Site Plan
January, 2004

Figure 8.3.4.4

8.3.4.5 Building 322 Site

Site Description: The former Building 322 was of WW II era administration building design, built from standardized Bureau of Yards and Docks plans **(HRA-1118, p 22)**. A site plan is provided in Figure 8.3.4.1 above and a floor plan is provided in Figure 8.3.4.5FP.

Former Uses: NRDL Office (called a "shack") **(HRA-1327 Encl 1, p 1)**, NRDL Instruments Branch **(HRA-2928, p 5)**, North Gate Pass Office **(HRA-333, p 16)**, and Field Office **(HRA-174, p 9)**.

Current Uses: Demolished.

Radionuclides of Concern: Cs-137, Pu-239, Ra-226, Sr-90, and Th-232.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Cs-137 found exceeding release limits. Remediated and resurveyed.

1955 NRDL Surveyed. Cleared below release limits **(HRA-224)**.

Contamination Potential: Likely.

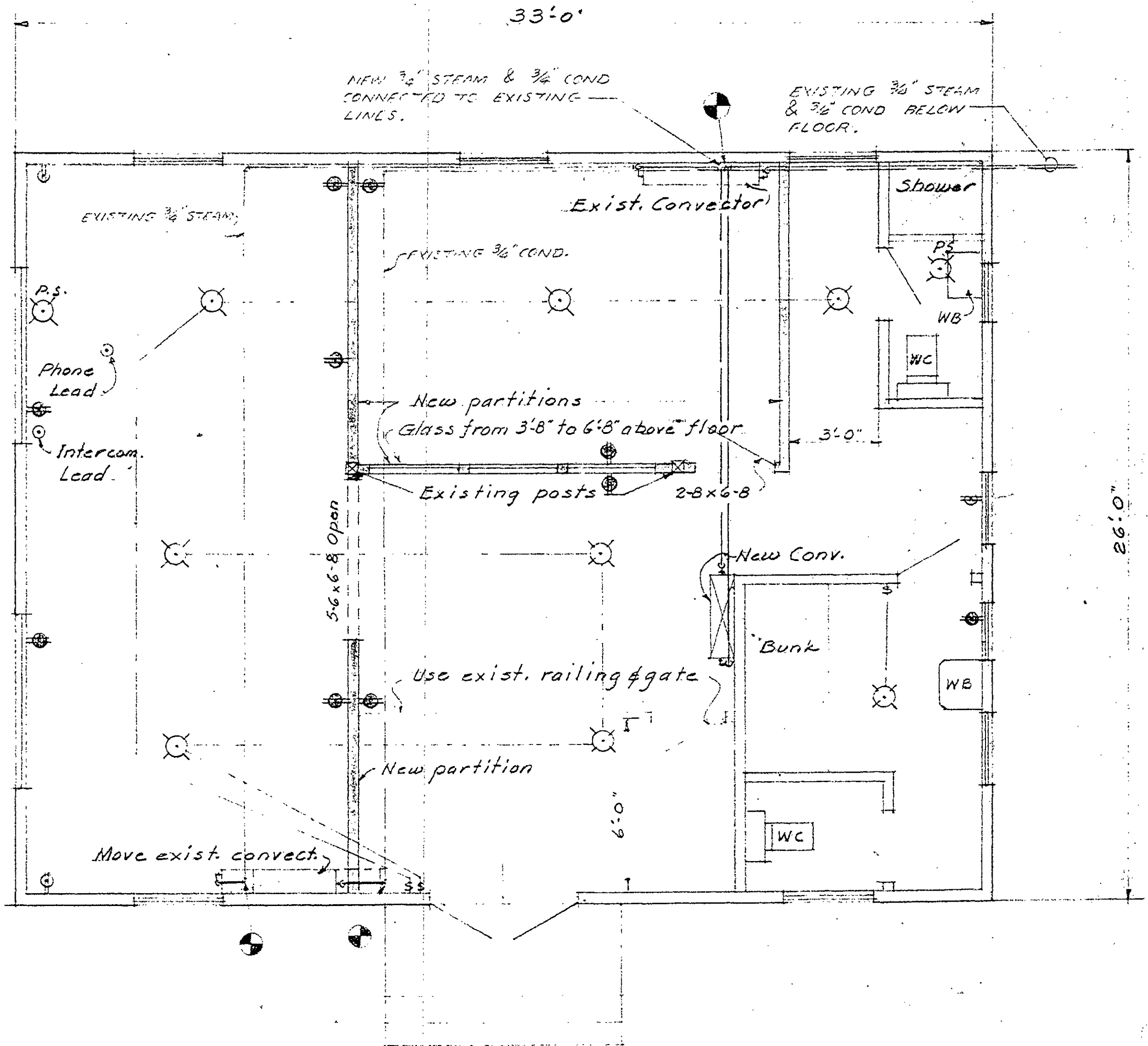
Contaminated Media:

Surface Soil: Low
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Recommended Actions: Review Final Status Survey Report.



FLOOR PLAN

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6 0 6

Scale in Feet

Notes:

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San Francisco CA
Historical Radiological Assessment

May, 2003

Figure 8.3.4.5 FP
Bldg. 322 Floor Plan

8.3.4.6 Building 351

Site Description: Building 351 is a WW II era shop building built of reinforced concrete that was constructed in 1945 and enlarged at a later date. The core building is three stories, with a flat roof and a five-story tower at the northwest corner **(HRA-1118, p 170)**. A building site plan is provided in Figure 8.3.4.4 above, and a floor plan is provided in Figure 8.3.4.6FP.

Former Uses: Electronics Work Area/Shop **(HRA-1327 Encl 1, p 1; HRA-4667)**, Optical Laboratories **(HRA-1327 Encl, 1 p 1)**, NRDL Materials and Accounts Division **(HRA-1586)**, NRDL Technical Information Division **(HRA-1990, p 3; HRA-2928, p 2)**, BUMED Storeroom **(HRA-2002, p 6)**, NRDL Office Services Branch **(HRA-2083, p 3)**, NRDL Thermal Branch **(HRA-2083, p 4)**, Machine Shop (on first floor), NRDL Engineering Division, NRDL Library, Sampling Laboratory, General Research Laboratories, and Biological Research Laboratories.

Current Uses: Unoccupied.

Radionuclides of Concern: Cs-137, Ra-226, Sr-90, and Th-232.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Surveys complete.

1955 NRDL surveyed. Cleared, below release limits of the period.

Contamination Potential: Likely.

Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Moderate
Drainage Systems: Low

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Recommended Actions: Review Final Status Survey Report.

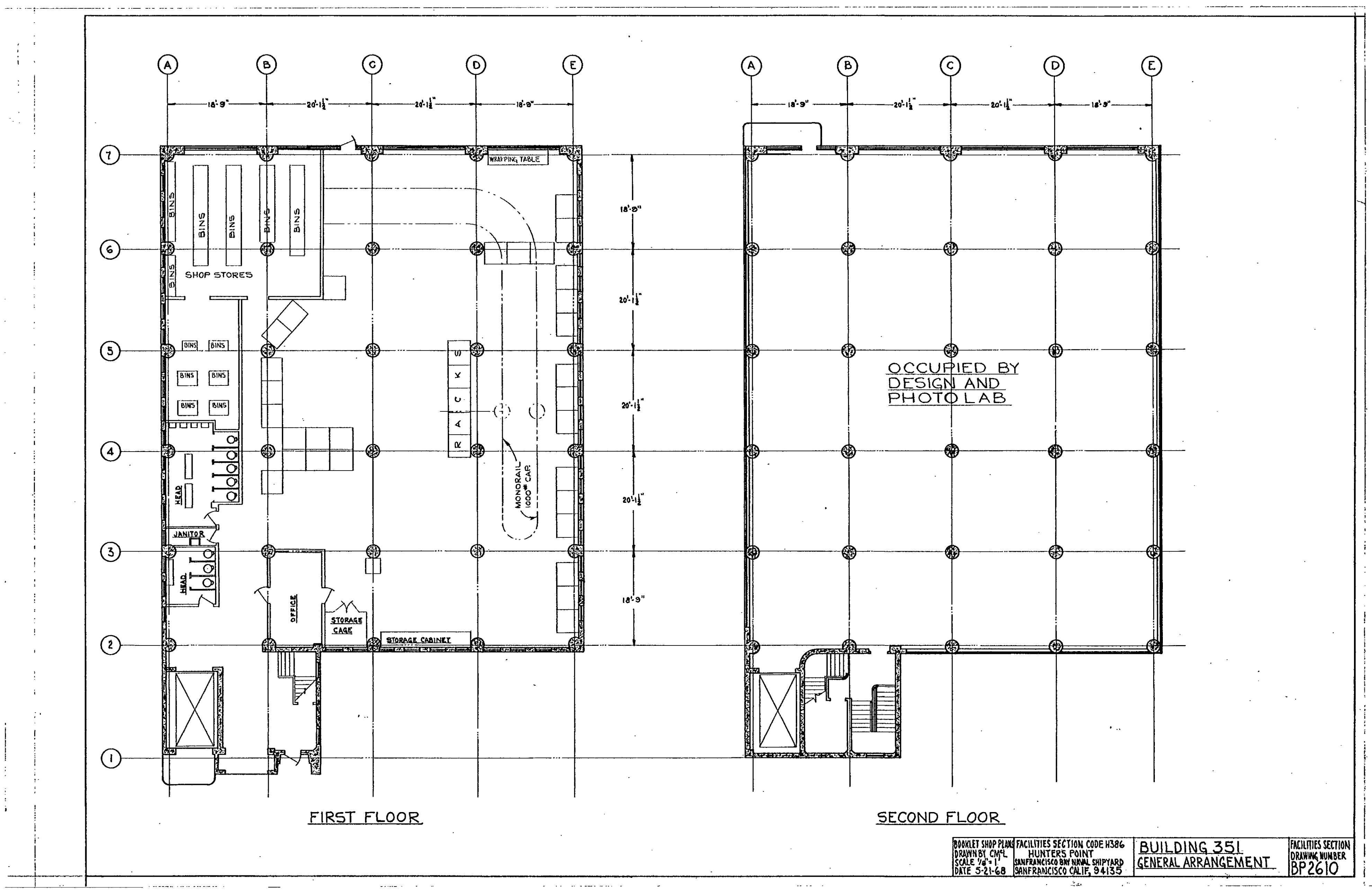

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Figure 8.3.4.6 FP
Building 351 - Floor Plan

8.3.4.7 Building 351A

Site Description: Building 351A is an addition connected to the south end of Building 351. It is a one-story concrete building constructed over a crawlspace. A building site plan is provided in Figure 8.3.4.4 above, and a floor plan is provided in Figure 8.3.4.7FP.

Former Uses: NRDL Chemical Technology Division **(HRA-1963, p 6; HRA-2065, p 3)**, Headquarters Guardpost **(HRA-2069, p 4)**, NRDL Physical Security, NRDL Applied Research Branch, NRDL Chemical Technology Division, NRDL Administrative Offices, NRDL Nuclear and Physical Chemistry Branch, NRDL Chemical and Physics Branch **(HRA-2928, pp 2, 4, 5)**, NRDL Analytical and Standards Branch, Instrument Repair Facility, Metrology Laboratory, Electronics Shop Annex **(HRA-4667)**, Material Storage Area, Instrument Calibration Laboratory, and Radiography Shop.

Current Uses: Unoccupied.

Radionuclides of Concern: Cs-137, Pu-239, Ra-226, Sr-90, and Th-232.

Previous Radiological Investigations:

2002 NWT Phase V investigation. Upper level surveys complete. Drain piping and small amounts of soil in crawlspace removed and disposed of due to Cs-137 contamination. Drainpipe removed across Cochran Street. Resurvey complete. Contamination remains outside the back steps of the building.

1955 NRDL Survey. Cleared to release limits for the period for return to shipyard except for drain lines left in place.

Contamination Potential: Known-Continued Access.

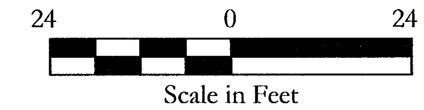
Contaminated Media:

Surface Soil: Moderate
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Moderate (crawlspace)
Drainage Systems: Moderate (crawlspace)

Potential Migration Pathways:

Surface Soil: Moderate
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low (crawlspace)
Drainage Systems: Low (crawlspace)

Recommended Actions: Characterization.



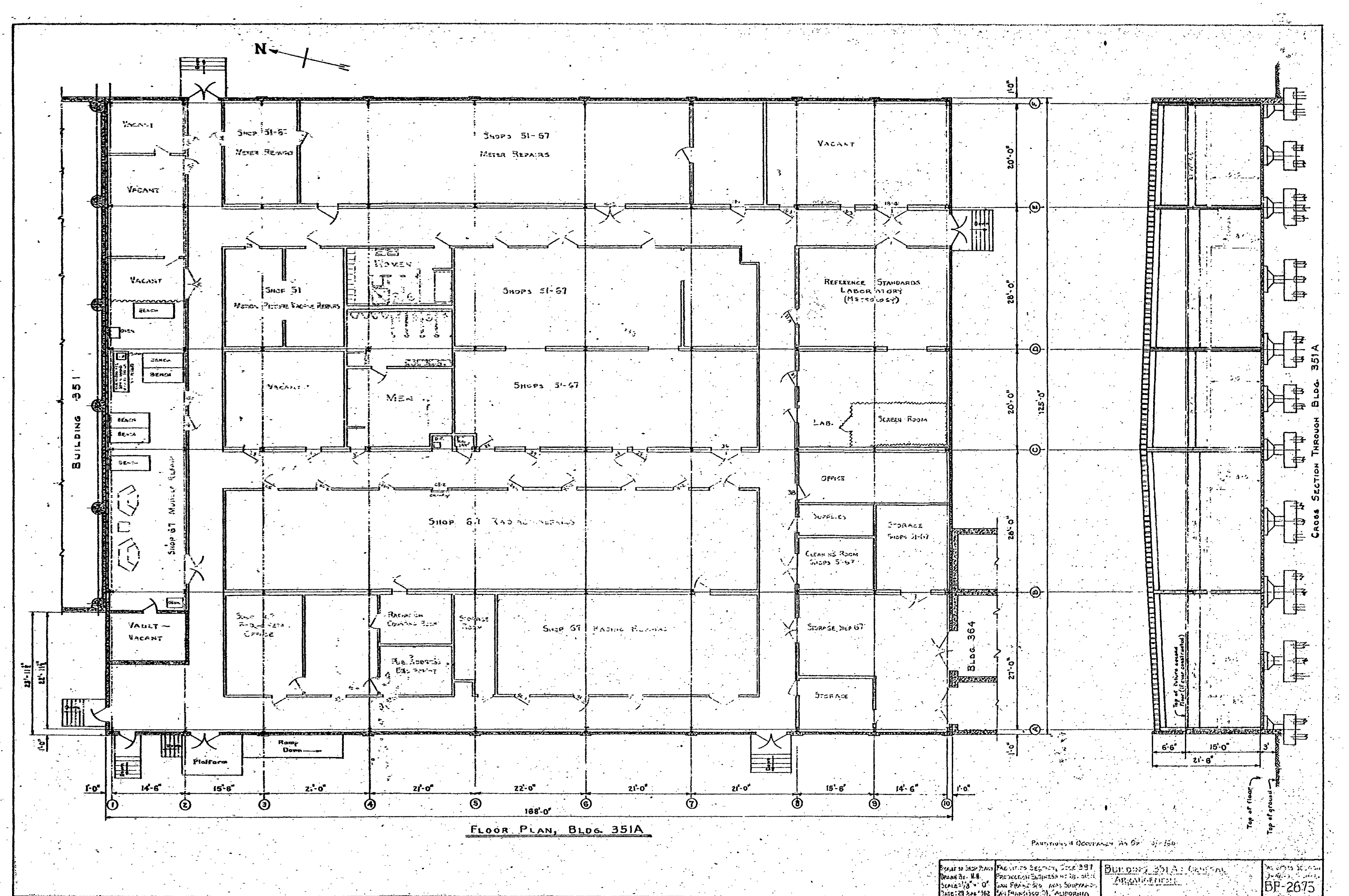


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Figure 8.3.4.7 FP
Building 351A - Floor Plan

8.3.4.8 Building 364

Site Description: Building 364 measures approximately 40 feet by 50 feet. A liquid radioactive waste collection area to the rear of the building contained a subsurface sump with a pumphouse on a concrete pad and two holding tanks. A building site plan is provided in Figure 8.3.4.4 above, and a floor plan is provided in Figure 8.3.4.8FP.

Former Uses: Animal Irradiation Facility, Liquid Radioactive Waste Collection Facility **(HRA-136; HRA-147; HRA-590)**, Hot Cell **(HRA-48; HRA-147; HRA-1331)**, Research Animal Facility **(HRA-48, p 8; HRA-600 Encl 3)**, Storage Building **(HRA-1331, p 1; HRA-4667)**, Isotope Processing and Decontamination Studies **(HRA-1095)**, General Research Laboratory, and Young Laboratories.

Current Uses: Unoccupied.

Radionuclides of Concern: Co-60, Cs-137, Pu-239, Ra-226, Sr-90, and U-235

Previous Radiological Investigations:

2002 NWT Phase V investigations. Cs-137 detected on building surfaces, piping in building crawlspace, and piping/trench outside rear of building. Areas remediated and resurveyed. Alpha and beta contamination remains in Room 107.

2001 NWT removal of waste tank pit. Areas met contemporary release criteria.

2001 NWT completes removal actions (peanut area) based on revised release limits. Surveys completed.

1996 ATG removal of "peanut spill" area. Subsequent survey and samples met the release criteria of the period.

1991 PRC Phase I investigations. Identified peanut area as exceeding release limits for the period.

1979 RASO survey. Decontamination and resurvey. Met release limits for the period.

1978 RASO survey. Noted areas of elevated activity. Decontaminated.

1969 AEC. Survey for clearance 24 December 1969, which included the yard and pit. Pipe outside building was concreted and allowed to remain in place. Areas met release criteria of the period.

Contamination Potential: Known-Continued Access

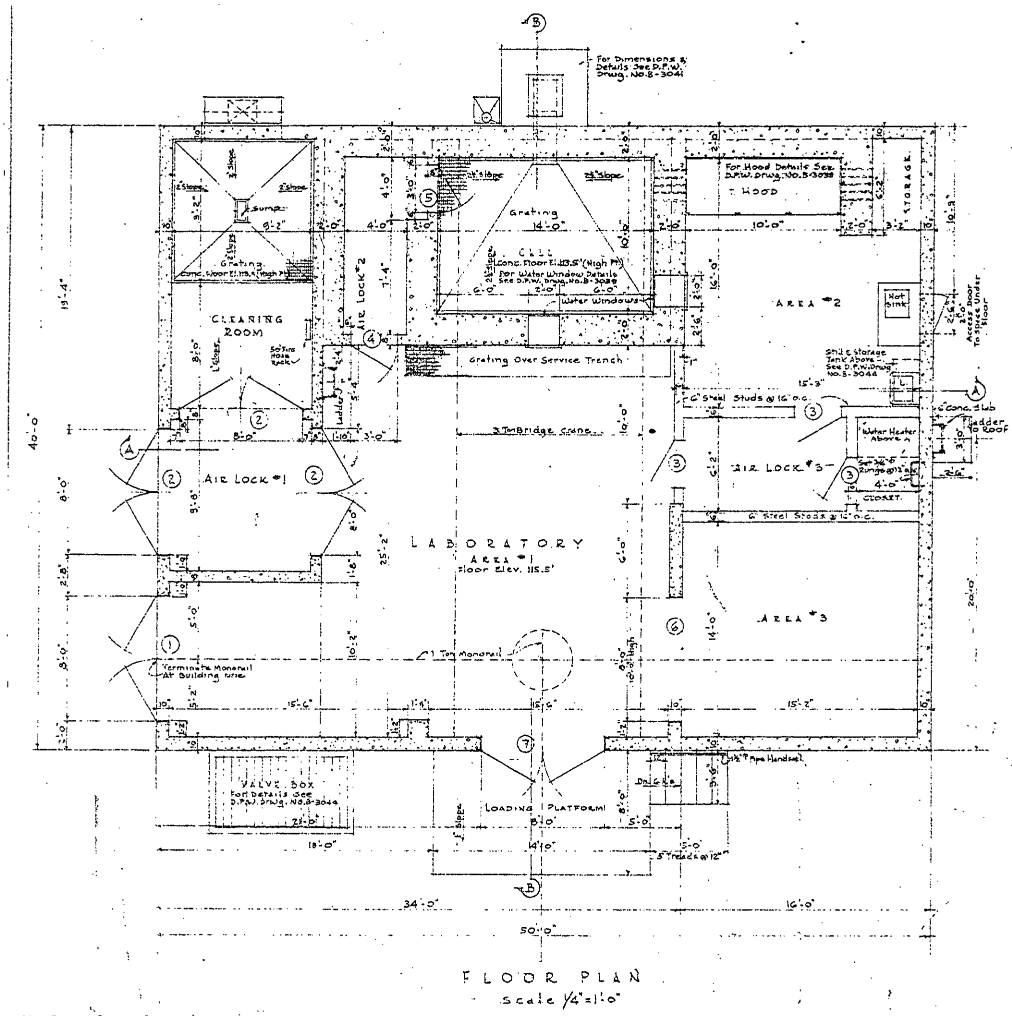
Contaminated Media:

Surface Soil: High
Subsurface Soil: Moderate
Surface Water: None
Groundwater: None
Air: None
Structures: High
Drainage Systems: High

Potential Migration Pathways:

Surface Soil: Moderate
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: Moderate
Drainage Systems: Moderate

Recommended Actions: Remediate known areas of contamination. Final Status Survey following remediation.



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Scale in Feet

Notes:

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San Francisco CA
Historical Radiological Assessment

May, 2003

Figure 8.3.4.8 FP
Bldg. 364 Floor Plan

8.3.4.9 Building 365

Site Description: Building 365 is a one-story wooden structure with a concrete foundation and measures 30 feet by 40 feet. A building site plan is provided in Figure 8.3.4.4 above.

Former Uses: Personnel Decontamination Facility **(HRA-136; HRA-147; HRA-431)**, Change House **(HRA-412; HRA-2928, p 5)**, Storage Building **(HRA-4667)**, and Small Animal Facility.

Current Uses: Unoccupied.

Radionuclides of Concern: Cs-137, Pu-239, Ra-226, Sr-90, and U-235.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Surveys complete.

1978 RASO survey. Results were less than instrument MDA.

1969 AEC survey. Clearance given 24 December 1969, based on release limits of the period.

Contamination Potential: Unlikely.

Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Recommended Actions: Review Final Status Survey Report.

8.3.4.10 Building 366 (Former Building 351B)

Site Description: Building 366 is a large corrugated metal, gable-roofed Butler-type structure, measuring approximately 280 feet by 130 feet. A building site plan is provided in Figure 8.3.4.10.

Former Uses: NRDL Instrument Calibration **(HRA-1036; HRA-1485)**; NRDL Administrative Offices **(HRA-1327, p 2)**; NRDL Applied Research and Technical Development Branches **(HRA-2022, p 6)**; Administrative Offices moved from D-19, 20, and 21 in 1952 **(HRA-1586)**; NRDL Radiological Safety Branch **(HRA-2018, p 5)**; NRDL Management Planning Division **(HRA-2030, p 3)**; NRDL Nucleonics Division **(HRA-2928, p 5)**; NRDL Instruments Evaluation Section; NRDL General Laboratories; NRDL Chemical Research Laboratory; Radiography Shop; Boat/Plastic Shop **(HRA-4667)**; Other Military/Navy Branch Project Officers Station **(HRA-2928, p 1)**; and NRDL Management Engineering and Comptroller Department **(HRA-2928, p 1)**.

Current Uses: Leased to San Francisco Redevelopment Agency. Currently used by 29 artists from The Point artists' colony.

Radionuclides of Concern: Cs-137, Ra-226, and Sr-90.

Previous Radiological Investigations:

2002/2003	Phase V investigations. Ventilation ducting and inactive floor drain indicated Cs-137 exceeding release limits. Remediation required.
2001	NWT Survey. No activity above background, but the survey protocol did not meet Phase V survey requirements.
1955	NRDL Surveys. Cleared below release limits by NRDL.

Contamination Potential: Known-Continued Access.

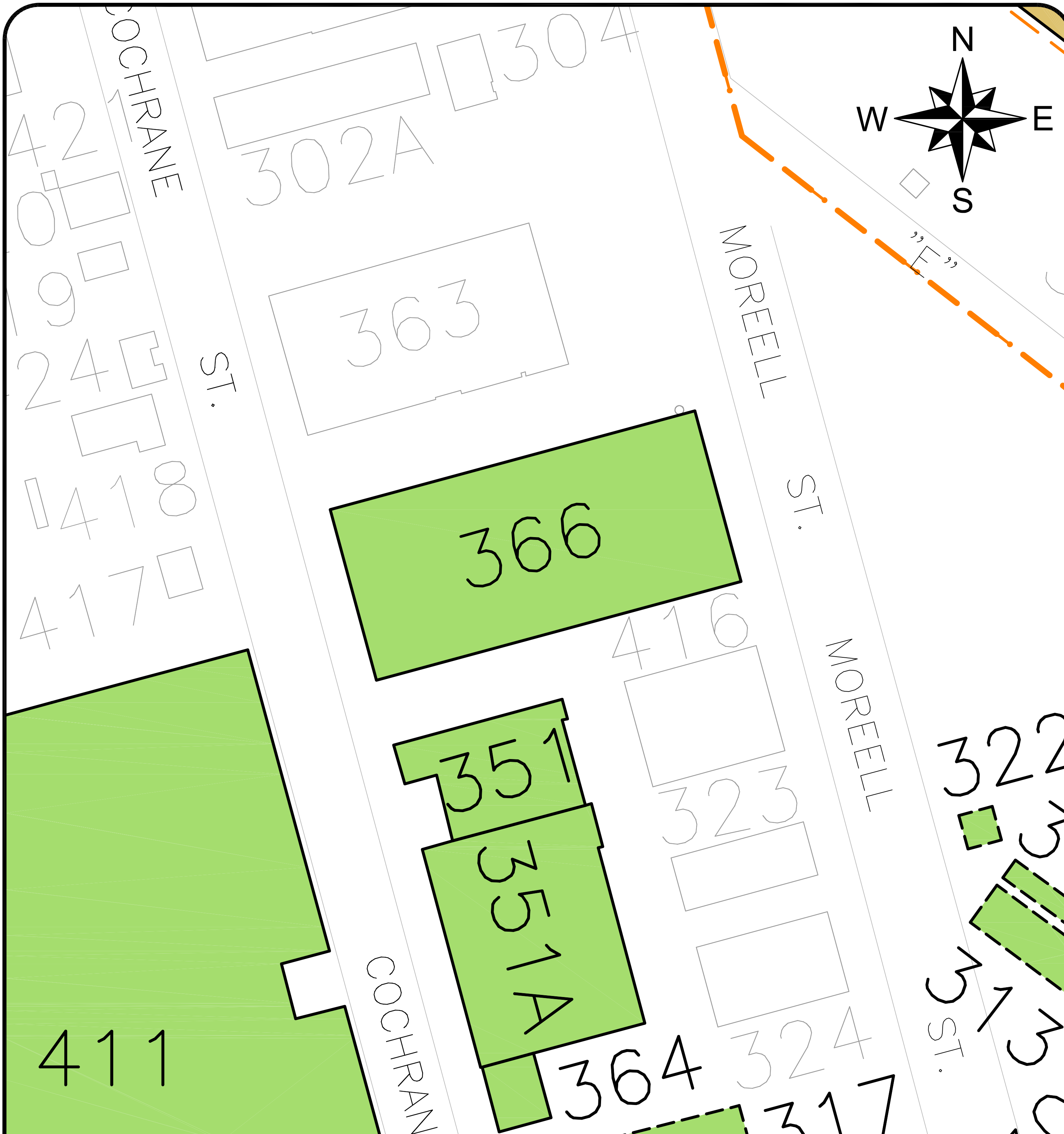
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Moderate
Drainage Systems: Moderate

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Recommended Actions: Remediate known areas. Conduct Final Status Survey.



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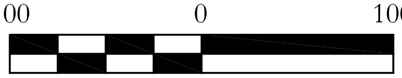


Scale in Feet

- Impacted Site with Designation
- Impacted Site with Designation (Demolished)
- IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

Bldg. 366 Site Plan

January, 2004

Figure 8.3.4.10

8.3.4.11 Building 383 Area

Site Description: Building 383 was built on the Gun Mole Pier in 1985 **(HRA-1118, p 49)**. It is a two-story steel and concrete, flat-roofed building, measuring approximately 110 feet by 60 feet. The area where the building is currently located has been identified as the site of a small building where radioluminescent devices were turned in after they were removed from ships. A building site plan is provided in Figure 8.3.4.11.

Former Uses: Turn-in area for radium devices removed from ships before this building was constructed.

Current Uses: Caretaker Site Office.

Radionuclides of Concern: H-3 (instruments and articles such as night vision devices and deck markers), Ra-226, and Sr-90.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Surveys complete. Found radioactive night vision device. Device did not exceed release limits. No spread of contamination. Device left in place.

Contamination Potential: Unlikely.

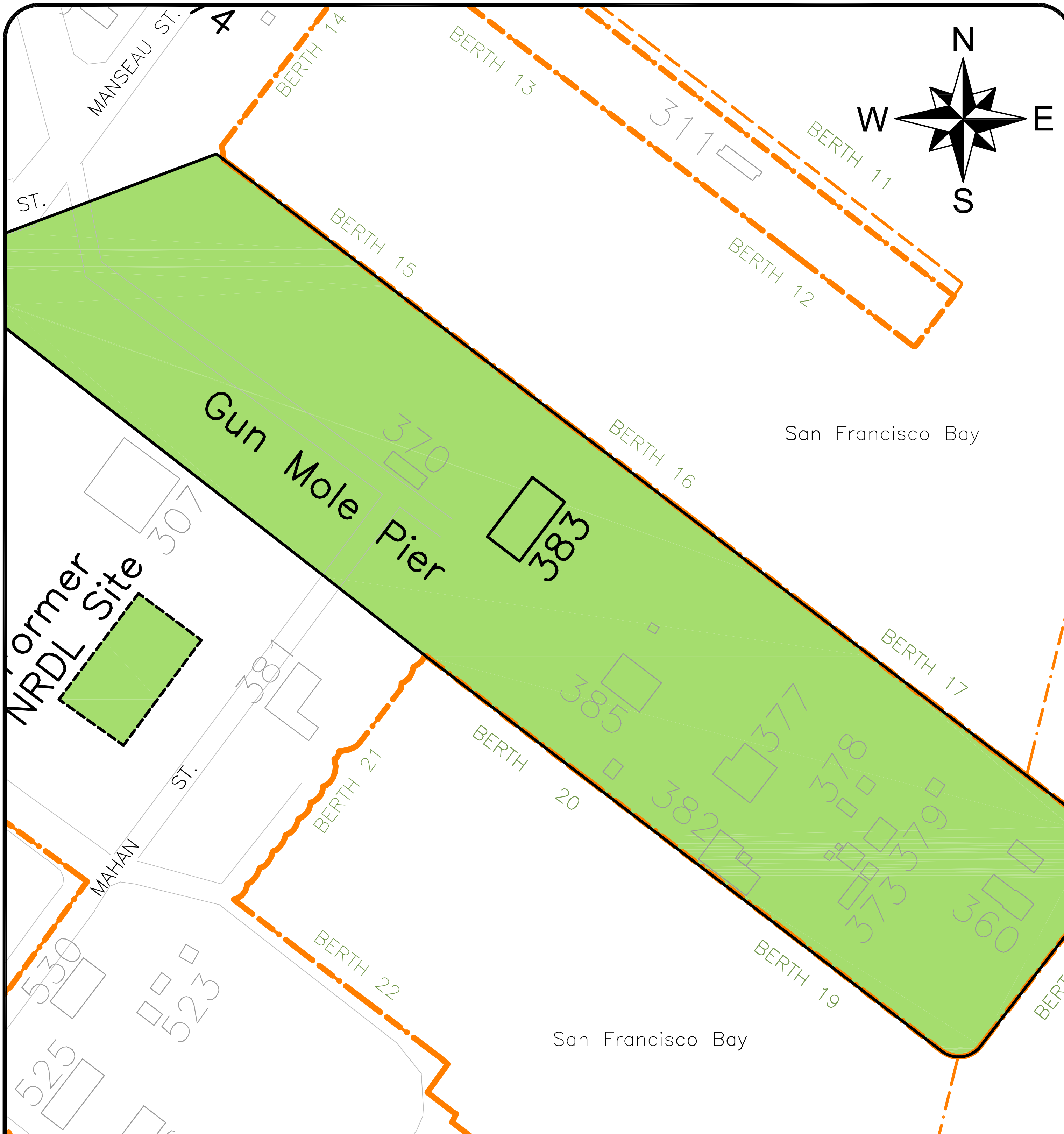
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Review Final Status Survey Report.



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200 0 200
Scale in Feet

Impacted Site with Designation
Impacted Site with Designation (Demolished)
Impacted IR Site w/ Designation
Non - Impacted Building
Non-Impacted Building (Demolished)
Topographic Feature
Parcel Boundary
All Berths shown are Impacted

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San Francisco CA
Historical Radiological Assessment

Bldg. 383 Site Plan

January, 2004

Figure 8.3.4.11

8.3.4.12 Building 408

Site Description: Building 408 houses a furnace/smelter that was constructed in 1947. The building is the equivalent of three stories at its northern side, dropping to one story at the south. It is open-sided on the north. Most of the east and west sides are sided in transite, a corrugated asbestos-concrete material. A firebrick-lined hearth occupies most of the open area at the north. Natural gas burners exist on the east and west sides the hearth. A pair of smokestacks extends from the lower rear segment of the building. A building site plan is provided in Figure 8.3.4.12.

Former Uses: Furnace-smelter **(HRA-1118, pp 153, 154)**.

Current Uses: Unused.

Radionuclides of Concern: Ra-226 from prior smelting operations and natural thorium in the firebrick.

Previous Radiological Investigations: None.

Contamination Potential: Likely.

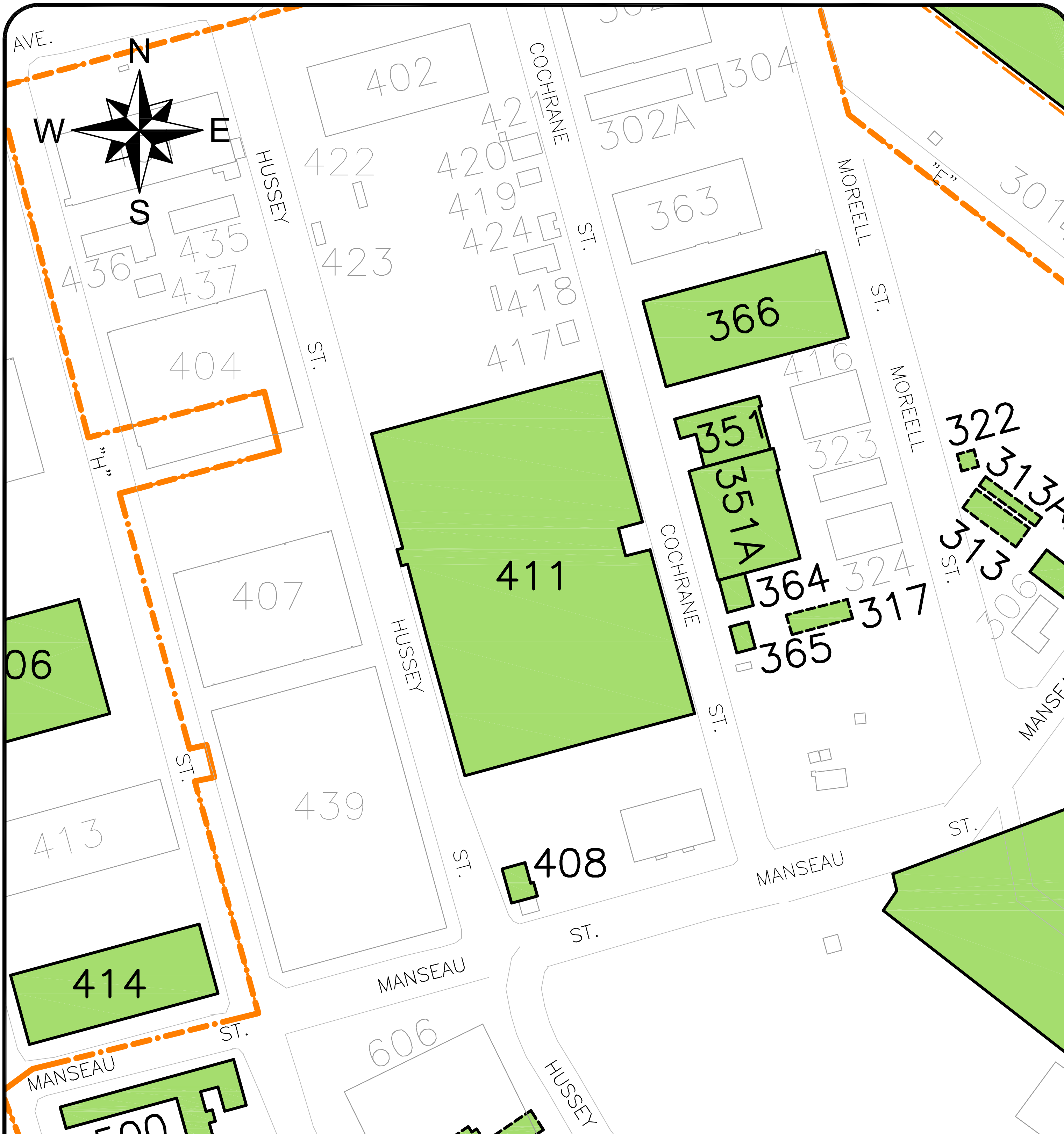
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Moderate
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Scoping Survey.



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200 0 200
Scale in Feet

- Impacted Site with Designation
- Impacted Site with Designation (Demolished)
- IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

Bldg. 408 & 411 Site Plan

January, 2004

Figure 8.3.4.12

8.3.4.13 Building 411

Site Description: Building 411 is a large curtain-walled, steel-framed building with a flat roof, located in the southern waterfront area. The building includes a saw-toothed series of rooftop monitors as well as bands of steel industrial sash and large glazed industrial doors. The building has two levels, with a taller segment to the north **(HRA-1118, pp 143-145)**. A building site plan is provided in Figure 8.3.4.12 above.

Former Uses: Source Storage **(HRA-548, p 2)**, Civilian Cafeteria, Radiography Shop, Shipfitters and Boilermakers Shop, and Ship Repair Shop.

Current Uses: Eric Lansdown (The Doll House) and Sierra Western Equipment.

Radionuclides of Concern: Co-60, Cs-137, and Ra-226.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Ra-226 found on second floor was within release limits. Surveys complete.

Contamination Potential: Unlikely.

Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Review Final Status Survey Report.

8.3.4.14 Gun Mole Pier

Bay End

Land End

Site Description: The Gun Mole Pier is a large flat area also known as the re-gunning pier. Buildings *360*, *370*, 374, 375, *376*, *377*, *378*, *379*, *380*, 382, *383*, *384,* and *385* are currently (in *italics*) or have been located on the Gun Mole. The major feature is a large 450-ton gantry crane originally used to remove gun turrets from ships. A site plan is provided in Figure 8.3.4.14, and a site layout is provided in Figure 8.3.4.14FP.

Former Uses: Radioactive Pavement Decontamination Study **(HRA-253; HRA-396)**, Decontamination Studies on NRDL Experimental Barge YFN-809 and on a Contaminated B-17 Aircraft **(HRA-1425; HRA-2669)**, Landing Area for NRDL Barge YFNX-16 Used as a Decontamination and Laboratory Facility **(HRA-253; HRA-396; HRA-4719)**. Decontamination facilities were also near Barge YFNX-16 **(HRA-253)**. The ex-INDEPENDENCE was berthed at the Gun Mole Pier and it was a loading point for radioactive wastes to an ocean disposal barge.

Current Uses: Unused.

Radionuclides of Concern: Cs-137, Pu-239, Ra-226, and Sr-90.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Areas containing Cs-137 exceeding release limits identified, remediated, and resurveyed. Additional surveys pending.

2001 Tetra Tech EM Inc. Survey of sections of pier based on map showing locations of NRDL barge. Readings comparable to background.

Contamination Potential: Likely.

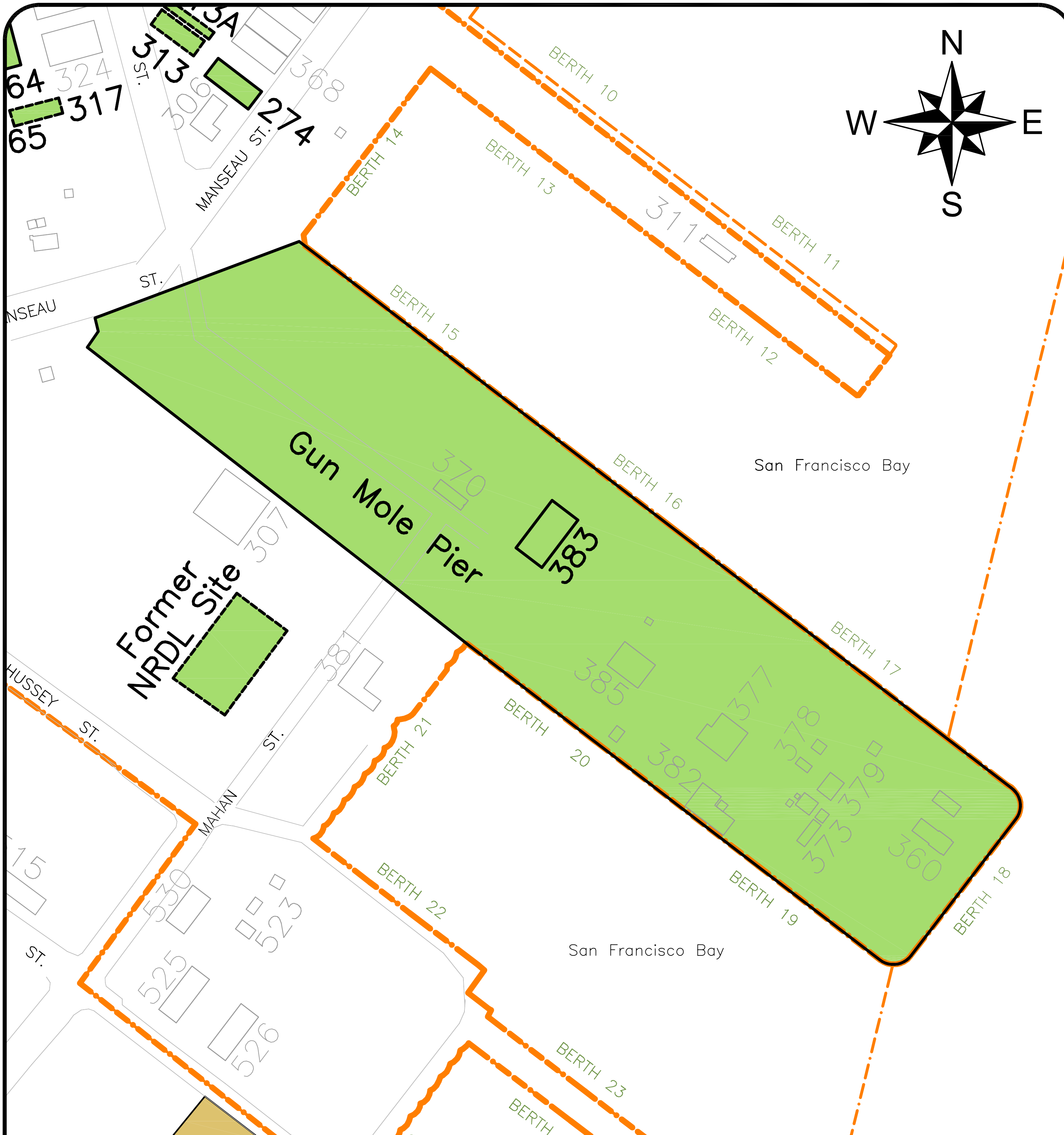
Contaminated Media:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Review Characterization Report.



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250 0 250

Scale in Feet

Impacted Site with Designation

Impacted Site with Designation (Demolished)

Impacted IR Site w/ Designation

Non - Impacted Building

Non-Impacted Building (Demolished)

Topographic Feature

Parcel Boundary

All Berths shown are Impacted

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

Gun Mole Pier & Berths
Site Plan
January, 2004

Figure 8.3.4.14

100 0 100

Scale in Feet

Notes:

Background image per Map ID 693.

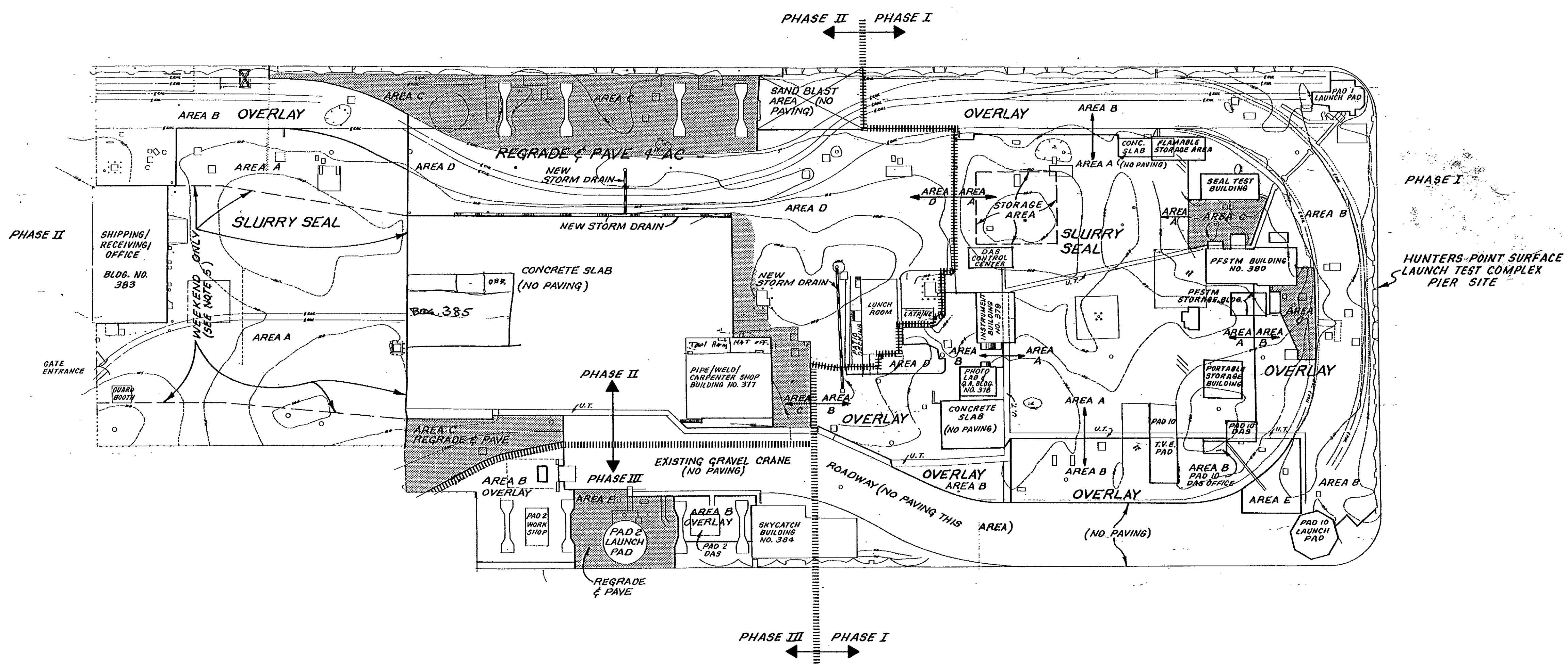

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Figure 8.3.4.14 FP
Gun Mole Pier - Site Layout

8.3.4.15 Building 500

Site Description: Building 500 is a two-story T-shaped wooden WW II temporary building, measuring 13,450 square feet on the foundation. A building site plan is provided in Figure 8.3.4.15.

Former Uses: NRDL Storage **(HRA-133)**, Barracks, Bachelor Officers Quarters (BOQ) **(HRA-2039, p 3)**, and NRDL Administrative Offices **(HRA-1442)**.

Current Uses: Unoccupied.

Radionuclides of Concern: Cs-137 and Ra-226.

Previous Radiological Investigations: None.

Contamination Potential: Unlikely.

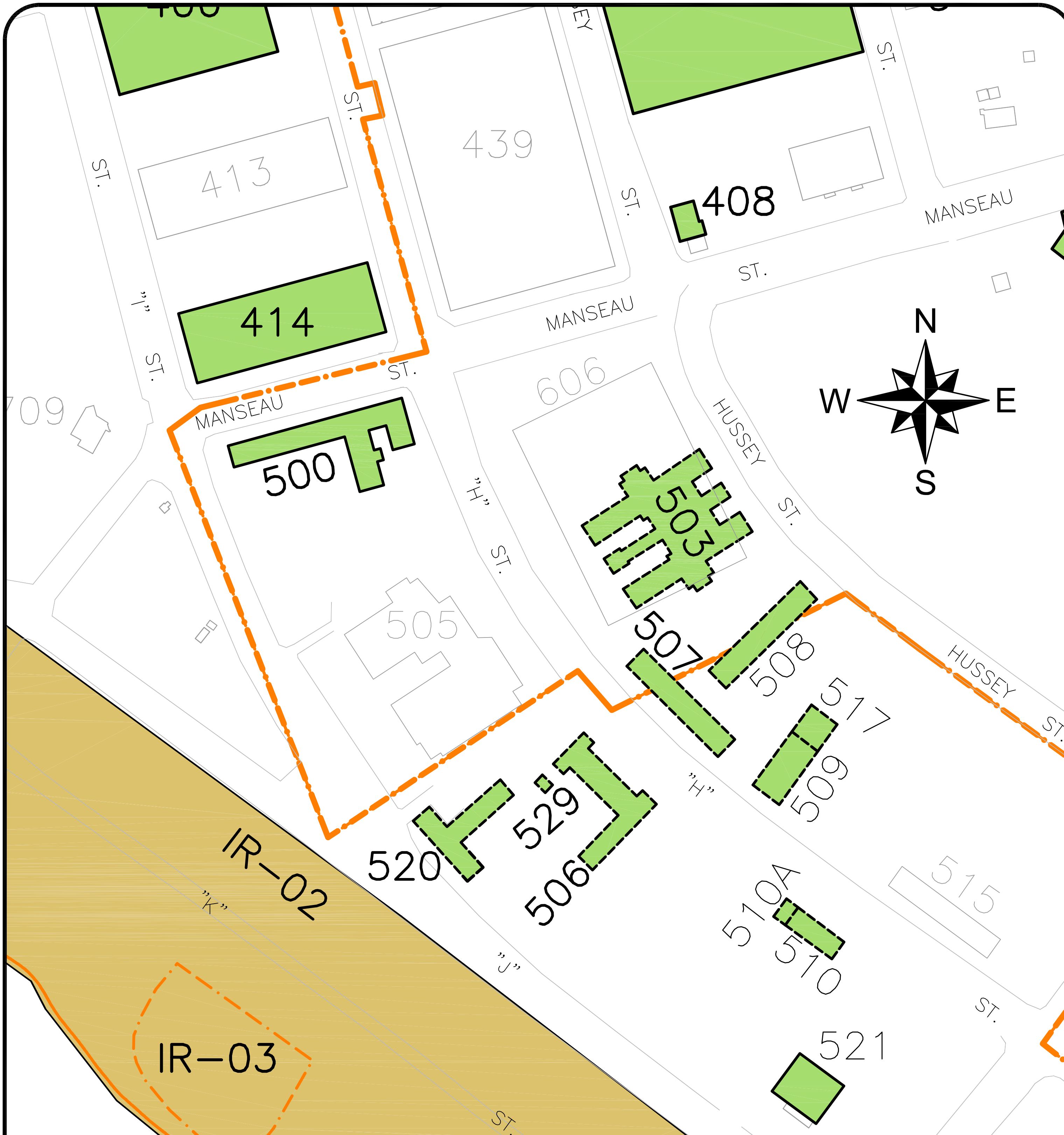
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Scoping Survey.



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200 0 200

Scale in Feet

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- Impacted Site with Designation (Demolished)
- Impacted IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

Bldg. 500 & 503 Site Plan

January, 2004

Figure 8.3.4.15

8.3.4.16 Former Building 503 Site

Site Description: The former Building 503 was irregular in construction and measured (from correlations of available historical maps) 25,900 square feet at the foundation. A building site plan is provided in Figure 8.3.4.15 above.

Former Uses: Ships Galley and Military Support Services **(HRA-516)** and NRDL Contaminated Laundry Facility **(HRA-254; HRA-516; HRA-2005, p 1)**.

Current Uses: Demolished. San Francisco Police Department facility (Building 606) built over original building's location.

Radionuclides of Concern: Cs-137, Ra-226, and Sr-90.

Previous Radiological Investigations: None.

Contamination Potential: Likely; if any drain piping remains.

Contaminated Media:

Surface Soil: None
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: Low

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: Low

Recommended Actions: Scoping Survey of any remaining drain system piping.

8.3.4.17 Former NRDL Site on Mahan Street

Site Description: The site was hand drawn on a circa 1949 map and annotated "Bldgs Now Occupied by NRDL" **(HRA-4755)**. It is approximately 300 feet north-northwest of Berth 21. A site plan is provided in Figure 8.3.4.17.

Former Uses: Unknown; Potential Storage Site of OPERATION CROSSROADS Material.

Current Uses: Open Area.

Radionuclides of Concern: Cs-137, Pu-239, Ra-226, and Sr-90.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Areas containing Cs-137 and Ra-226 in soils exceeding release limits identified. Remediated and resurvey complete.

Contamination Potential: Likely.

Contained Media:

Surface Soil: Moderate
Subsurface Soil: Moderate
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Recommended Actions: Review Final Status Survey Report.

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200 0 200
Scale in Feet

Impacted Site with Designation
Impacted Site with Designation (Demolished)
Impacted IR Site w/ Designation
Non - Impacted Building
Non-Impacted Building (Demolished)
Topographic Feature
Parcel Boundary
All Berths shown are Impacted

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

Former NRDL Site Plan

January, 2004

Figure 8.3.4.17

8.3.5 Parcel E Impacted Sites

8.3.5.1 Building 406

Site Description: Building 406 is a common wood-framed, flush weather-boarded warehouse and shop-type building from WW II. The building is approximately 40,000 square feet **(HRA-171, p 6)** and includes a central light and ventilation monitor joined by shallow shed roofs at either side. At the center of the building is a pair of wooden sliding industrial doors, surfaced with diagonal boards. A building site plan is provided in Figure 8.3.5.1.

Former Uses: Shipping, Packing, and Preserving **(HRA-171, p 6)** and B&A Bodyworks and Towing.

Current Uses: Unoccupied.

Radionuclides of Concern: Cs-137 and Ra-226.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Areas containing Ra-226 exceeding release limits identified. Remediated and resurvey complete.

Contamination Potential: Likely.

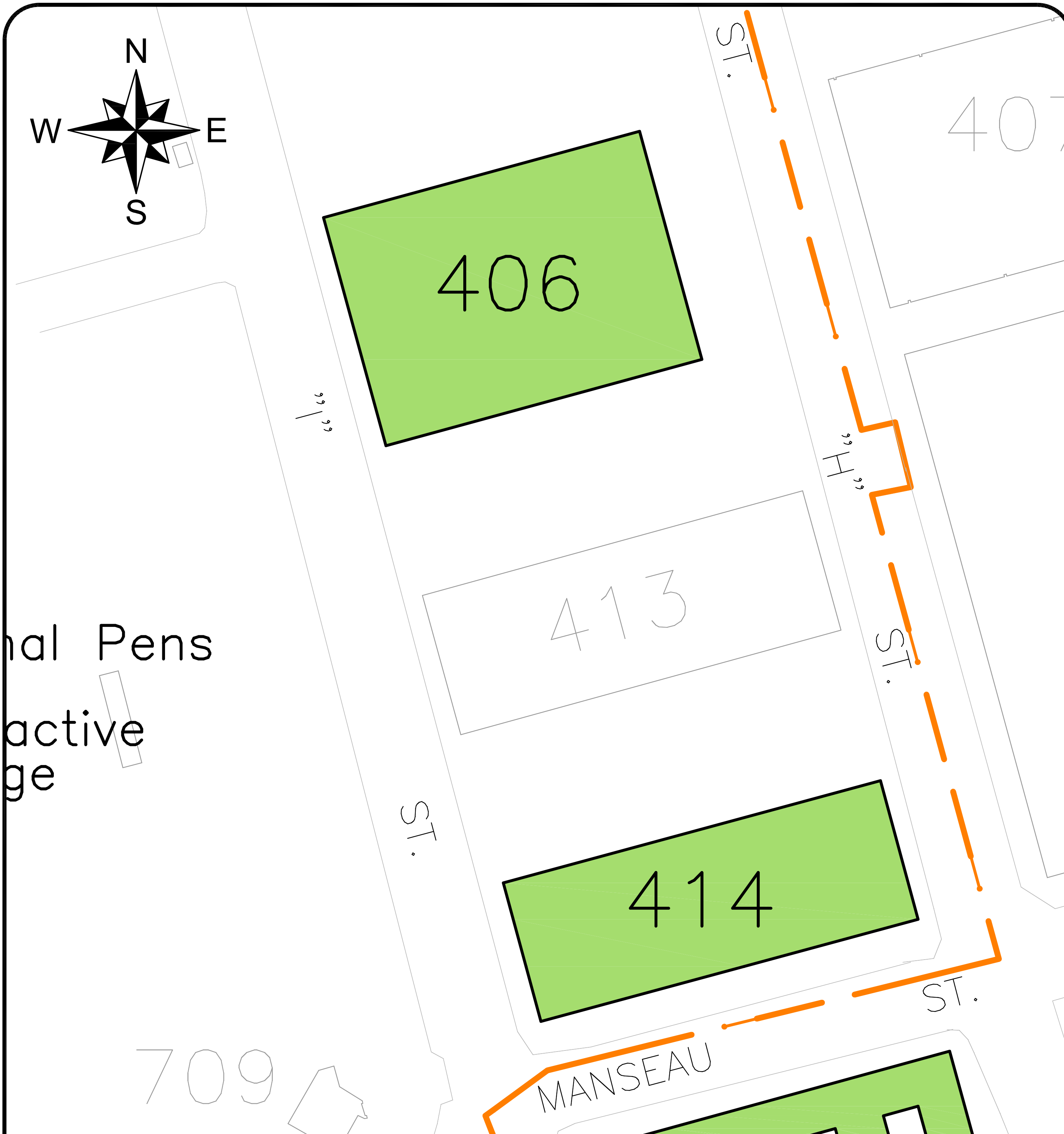
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Moderate
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Review Final Status Survey Report.



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100 0 100

Scale in Feet

- Impacted Site with Designation
- Impacted Site with Designation (Demolished)
- IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

Bldg. 406 & 414 Site Plan

January, 2004

Figure 8.3.5.1

8.3.5.2 Building 414

Site Description: Building 414 is a wood-framed, corrugated metal-sided, 172-by-243-foot shop in the southern shipyard area that includes a tall, gabled main shop area with a shed-roofed extension to one side. There are shop monitors (windows) on what is equivalent to the second story. A building site plan is provided in Figure 8.3.5.1 above.

Former Uses: LLRW Storage Area for RI IDW (PRC) **(HRA-1274; HRA-1453, p 2)**, Public Works/Supply Storehouse **(HRA-4667)**, and Shaw.

Current Uses: Contractor Storage.

Radionuclides of Concern: Ra-226, from IDW Storage.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Surveys complete.

Contamination Potential: Unlikely.

Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Review Final Status Survey Report.

8.3.5.3 Site of Former 500 Series Buildings

Site Description: The area of HPS where the 500 series buildings were located is of significance because the original RADLAB/NRDL facilities were located there. In addition to the buildings described individually below, temporary structures were constructed, used, and removed, and radioactive materials were transported and stored outdoors. There were drain lines in buildings in the area, a dust collection system was constructed outside Building 506 for use by NRDL, and there is anecdotal indication of a spill of Sr-90 near Building 506. A site plan is provided in Figure 8.3.5.3.

Former Uses: Site of Original RADLAB/NRDL Administrative and Laboratory Facilities and Outdoor Storage.

Current Uses: Demolished buildings and open space.

Radionuclides of Concern: Am-241, Cs-137, Pu-239, Ra-226, and Sr-90.

Previous Radiological Investigations: None.

Contamination Potential: Likely; from historical search regarding temporary building construction, use and demolition, outdoor storage, and transit of radioactive materials and probable drain piping.

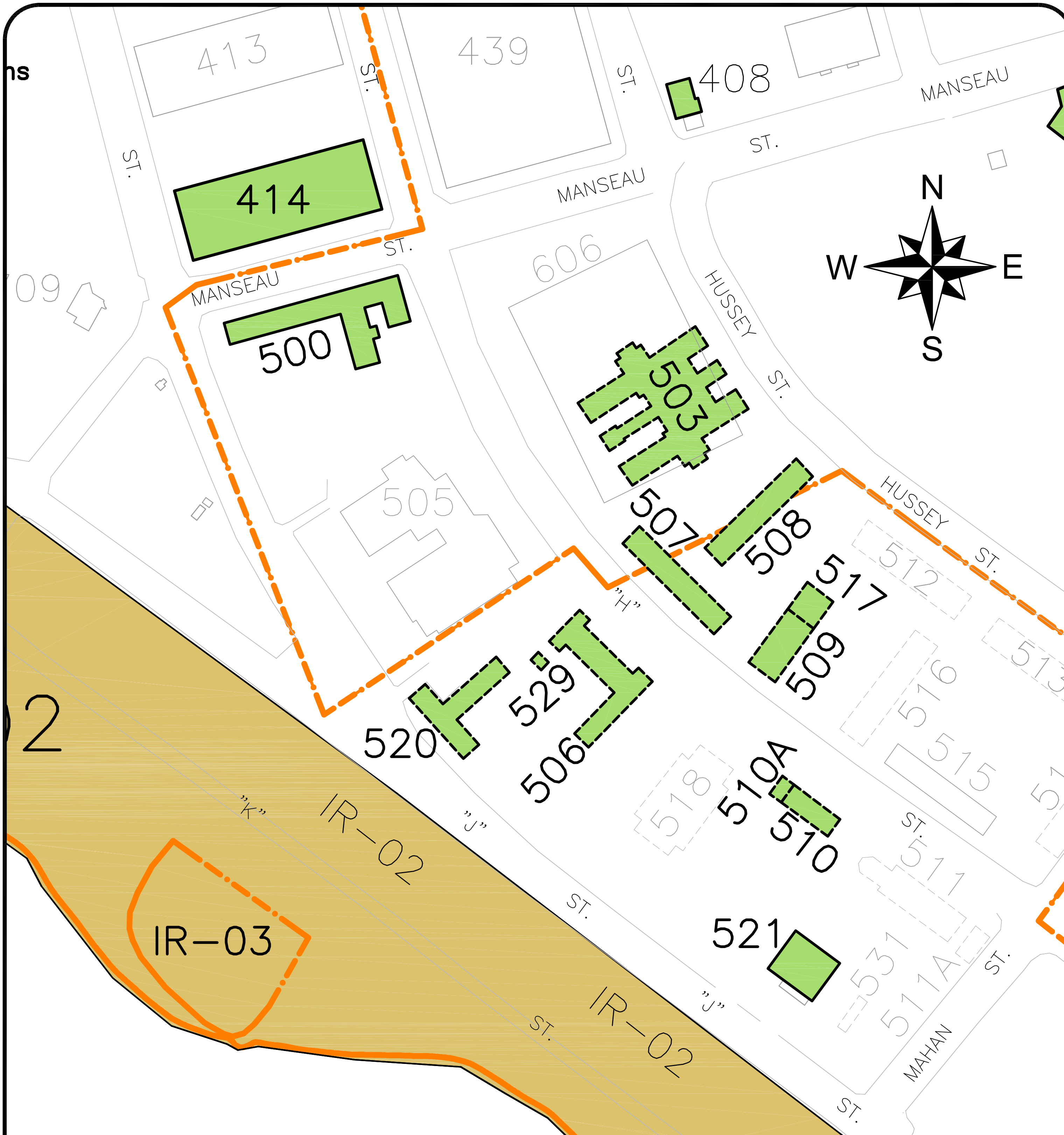
Contaminated Media:

Surface Soil: Moderate
Subsurface Soil: High
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: High

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Moderate
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: High

Recommended Actions: Scoping Survey.



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Scale in Feet

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- IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

500 Series Bldgs. Site Area

January, 2004

Figure 8.3.5.3

8.3.5.4 Former Building 506 Site

Site Description: From correlations of available historical maps, the former Building 506 was irregular in construction and measured 9,375 square feet at the foundation. A site plan is provided in Figure 8.3.5.3 above, and a floor plan is provided in Figure 8.3.5.4FP.

Former Uses: Radioactive Waste Containers Stored on Pad Behind Building **(HRA-361; HRA-1077)**; NRDL Biology and Health Physics Laboratories; Animal, Nuclear and Physical Chemistry Laboratories **(HRA-1327, p 1, Encl 1 p 2)**; Radioactive Waste Storage Tank **(HRA-1508)**; NRDL Chemistry Laboratories **(HRA-1601 Encl A)**; Radiochemistry Laboratory **(HRA-418; HRA-1497 Encl B, pp 1-2)**; NRDL Instrument Repair, Darkroom, and Densitometer for Film Badges; Counting Rooms; Electro-Physical and Surface Chemistry Laboratories; Administrative Offices; Storerooms; Duty Watch Berthing; Personnel Decontamination **(HRA-1773)**; and RADLAB/NRDL Headquarters and Main Facility Prior to Move to Building 815 in 1955 **(HRA-1819)**.

Current Uses: Demolished.

Radionuclides of Concern: Am-241, Cs-137, H-3, Pu-239, Ra-226, and Sr-90.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Class 3 survey complete.

1996 PRC Phase III investigation. Survey results below release limit for the period.

1978 RASO survey of former NRDL buildings. Three areas of elevated activity noted and decontaminated below release limits for the period.

1969 Final AEC clearance given 24 December 1969.

1969 NRDL release survey. H-3 contamination found and removed.

Contamination Potential: Likely; from historical research regarding waste tank and drain piping.

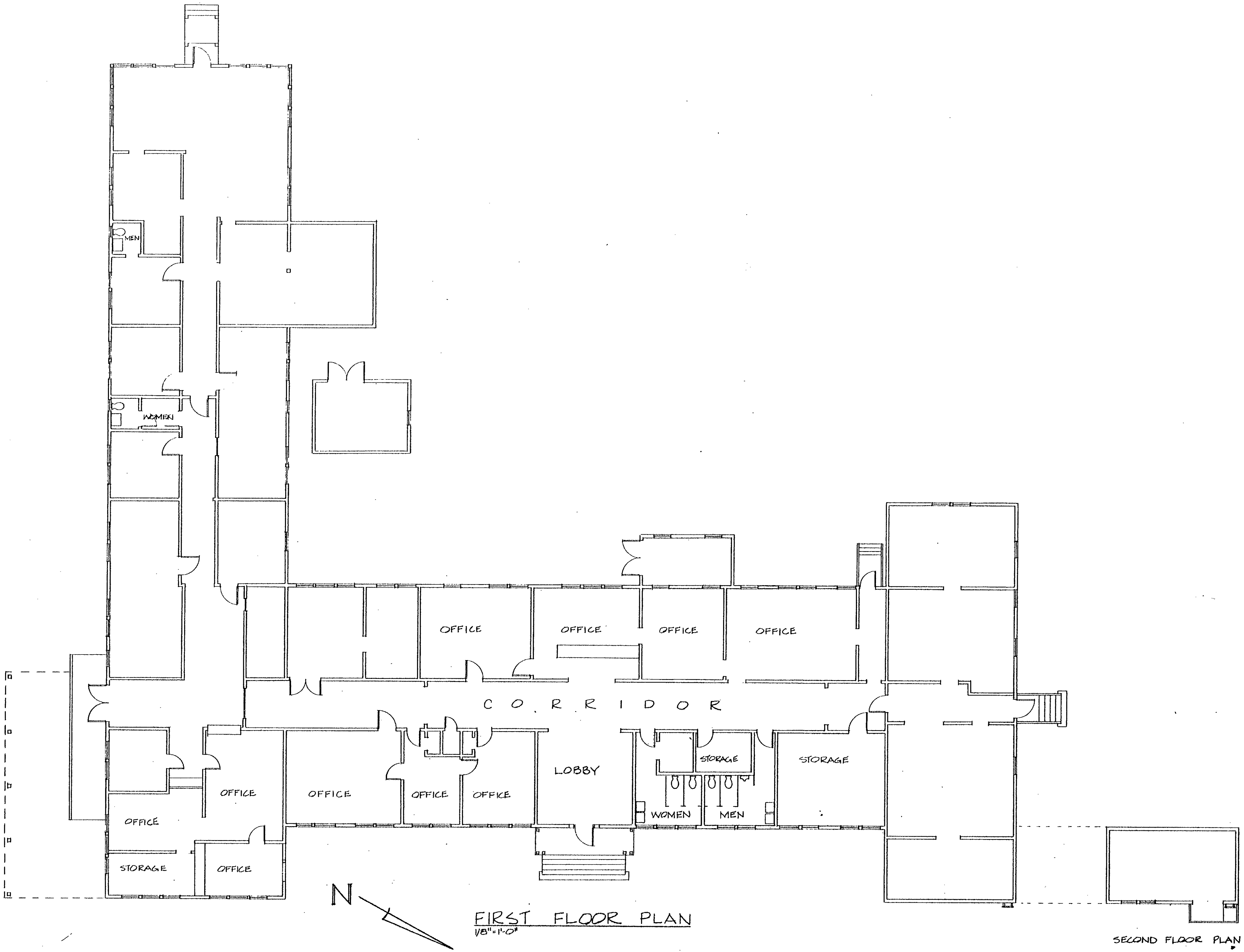
Contaminated Media:

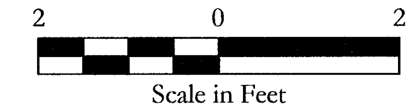
Surface Soil: Moderate
Subsurface Soil: Moderate
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: Moderate

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: Moderate

Recommended Actions: Scoping Survey based on recent drainage system information from historical drawings.





Notes:

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Figure 8.3.5.4 FP
Building 506 - Floor Plan

8.3.5.5 Former Building 507 Site

Site Description: Based on approximations from available historical maps, the original Building 507 measured approximately 35 feet by 190 feet. From historical files, it appears to have been constructed as a wooden-framed, corrugated building. A site plan is provided in Figure 8.3.5.3 above, and a floor plan is provided in Figure 8.3.5.5FP.

Former Uses: NRDL Biology Laboratories **(HRA-1327, p 2)**, NRDL Change House and Animal Quarters **(HRA-354 Encl B, p 2; HRA-1756 Encl B, p 1)**, Radiological Decontamination Center **(HRA-1500, p 1)**, Biochemistry Branch, Physiology-Psychology Branch, and Experimental Pathology Branch **(HRA-2928, p 4).**

Current Uses: Demolished.

Radionuclides of Concern: Cs-137, Pu-239, Ra-226, and Sr-90.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Ra-226 exceeded release limits. Remediated. Resurvey completed.

1996 PRC Phase III Investigation. Released for public use.

1955 NRDL Surveyed. Cleared below contemporary release limits

Contamination Potential: Likely; primarily in drain system based on historical drain system information.

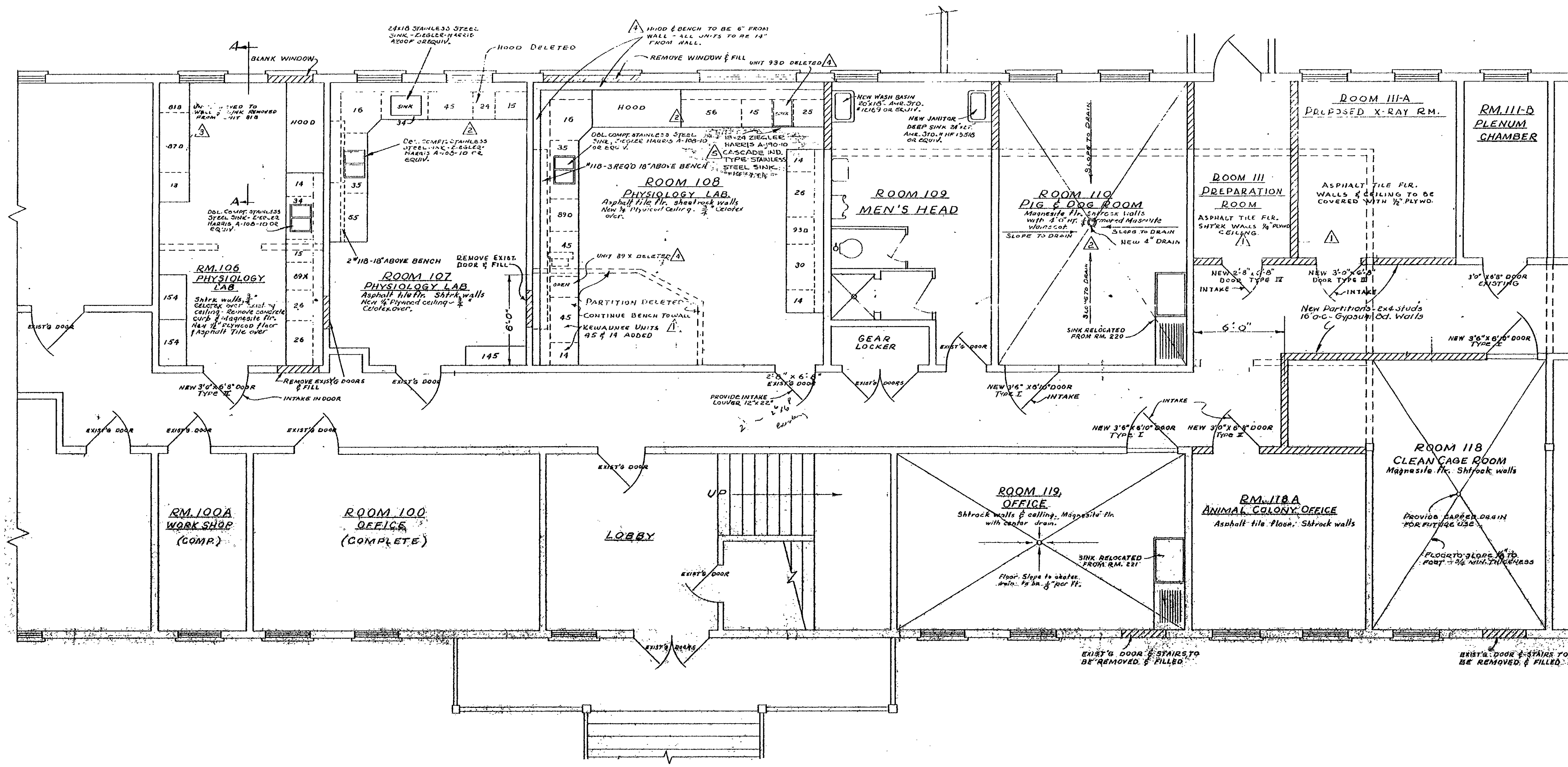
Contaminated Media:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: Moderate

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: Low

Recommended Actions: Characterization Survey based on historical information on drain systems.



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Scale in Feet

Notes:

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Figure 8.3.5.5 FP
Building 507 - Floor Plan

8.3.5.6 Former Building 508 Site

Site Description: From correlations of available historical maps, the original Building 508 measured approximately 35 feet by 190 feet. A site plan is provided in Figure 8.3.5.3 above, and a floor plan is provided in Figure 8.3.5.6FP.

Former Uses: Chemistry Branch **(HRA-1327)**, Library **(HRA-1846)**, Personnel Branch **(HRA 1955)**, Photographic Section of Publications Branch, Personnel Branch, Radiological Safety Branch, Barracks **(HRA-1958)**, Health Services Division **(HRA-1976)**, Chemical Technology and Nucleonics Divisions **(HRA-1990)**, Security Division **(HRA-2064)**, Health Physics Division **(HRA-2080)**, Employee Relations Branch **(HRA-2126)**, Photographic and Illustrating Sections, and Pathology Laboratory **(HRA-2928)**.

Current Uses: Demolished.

Radionuclides of Concern: Cs-137, Ra-226, and Sr-90.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Initial surveys complete.

1996 PRC Phase III investigations. Background levels only detected. Released for public use.

1955 NRDL surveys. Cleared below release limits by NRDL.

Contamination Potential: Likely (drain systems primarily).

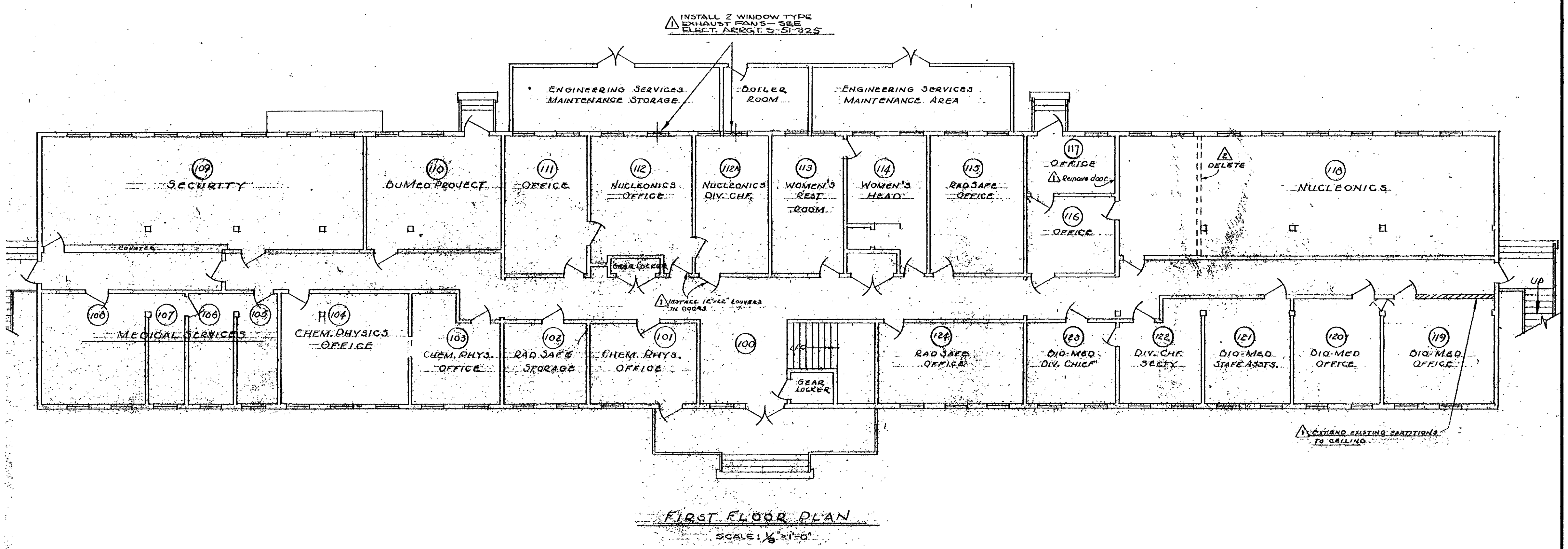
Contaminated Media:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: Moderate

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: Low

Recommended Actions: Characterization Survey of site and drain system based on information from historical documents.



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Scale in Feet

Notes:

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Figure 8.3.5.6 FP
Building 508 - Floor Plan

8.3.5.7 Former Building 509 Site

Site Description: From correlations of available historical maps, the original Building 509 was irregular in construction and measured approximately 50 feet by 100 feet. A site plan is provided in Figure 8.3.5.3 above.

Former Uses: Library **(HRA-4667)**. There is no existing reference to this building as a use area nor is it mentioned in the building-by-building Pu-239 and Ra-226 release survey of 1955 when NRDL consolidated **(HRA-1327)**. This building was adjacent to Building 517.

Current Uses: Demolished.

Radionuclides of Concern: Cs-137 and Sr-90

Previous Radiological Investigations:

2002 NWT Phase V investigations. Survey completed.

2001 NWT completes soil removal actions in adjacent area.

1996 PRC Phase III investigations. Recommends evaluation/removal of anomalous readings between Buildings 509 and 517.

Contamination Potential: Likely.

Contaminated Media:

Surface Soil: Low
Subsurface Soil and Media: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: Moderate

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: Low

Recommended Actions: Characterization Survey of site and drainage system.

8.3.5.8 Former Building 510 Site

Site Description: From correlations of available historical maps, the original Building 510 measured approximately 30 feet by 85 feet. A site plan is provided in Figure 8.3.5.3 above, and a floor plan is provided in Figure 8.3.5.8FP.

Former Uses: Weapons Test Sample Storage **(HRA-147; HRA-1106)**, Non-NRDL Training Facility **(HRA-336, p 11; HRA-1105)**, NRDL Radiation Facility **(HRA-336, p 11)**, Glassblowing, Woodworking and Machine Shops **(HRA-1327, p 3; HRA-1796, p 3)**, Physics Branch **(HRA-1959, p 4)**, Nuclear Radiation Branch, and Research Engineering Section Physics Branch **(HRA-2076)**.

Current Uses: Demolished.

Radionuclides of Concern: Cs-137, Pu-239, Ra-226, and Sr-90.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Class 3 survey complete.

1996 Phase III investigations: survey and soil sampling. No anomalous readings found.

1955 NRDL surveys. Cleared below release limits by NRDL.

Contamination Potential: Likely.

Contaminated Media:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: Moderate

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: Low

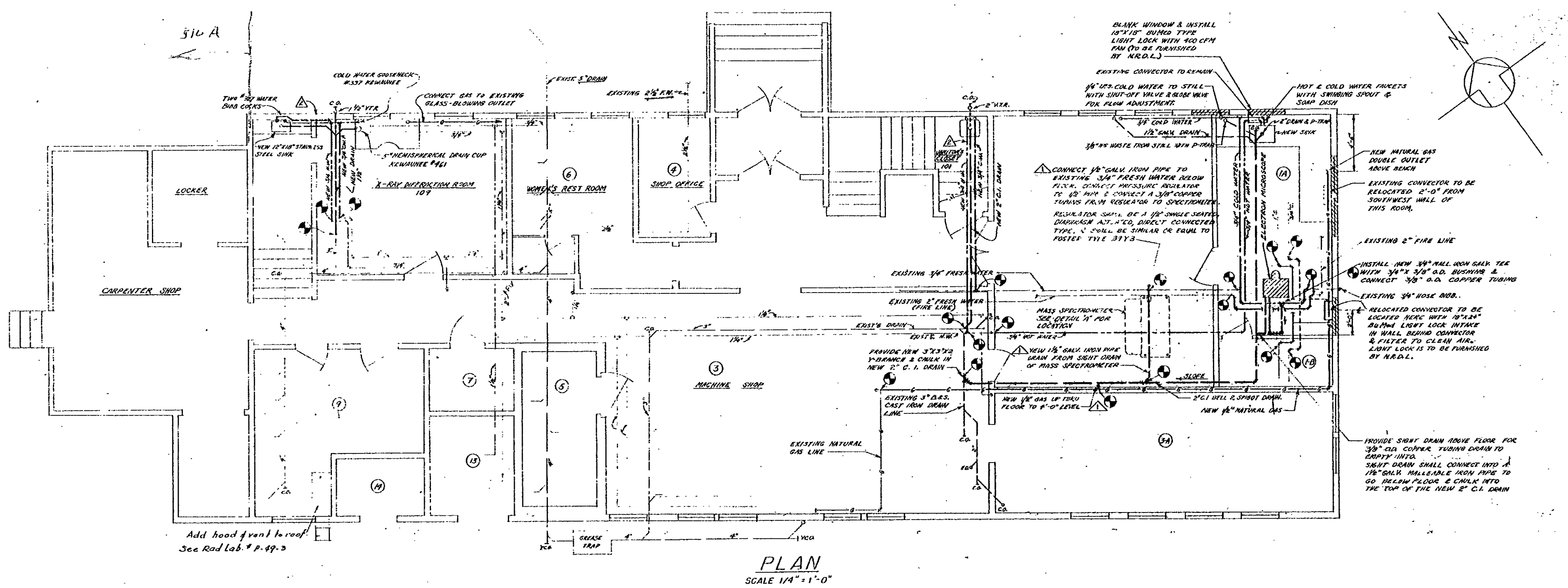
Recommended Actions: Class 1 Characterization Survey of site and any remaining drainage system.

4 0 4

Scale in Feet

Notes:

Background image per Map ID 489.



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San Francisco CA

Historical Radiological Assessment

May, 2003

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Figure 8.3.5.8 FP
Building 510 - Floor Plan

8.3.5.9 Former Building 510A Site

Site Description: The original Building 510A measured approximately 30 feet by 20 feet and was adjacent to Building 510. A site plan is provided in Figure 8.3.5.3 above, and a floor plan is provided in Figure 8.3.5.9FP.

Former Uses: NRDL Kevatron Facility **(HRA-136, p 2)**, NRDL X-Ray Facility **(HRA-147)**, SUPSHIPS Record Storage **(HRA-536)**, and Fire Research Facility **(HRA-316; HRA-536)**.

Current Uses: Demolished.

Radionuclides of Concern: Cs-137 and Sr-90.

Previous Radiological Investigations:

2002 NWT Phase V investigations.

1996 PRC Phase III investigations. Survey and soil sampling. Recommended release for unrestricted use based on limits for the period.

Contamination Potential: Likely, including any remaining drain system piping.

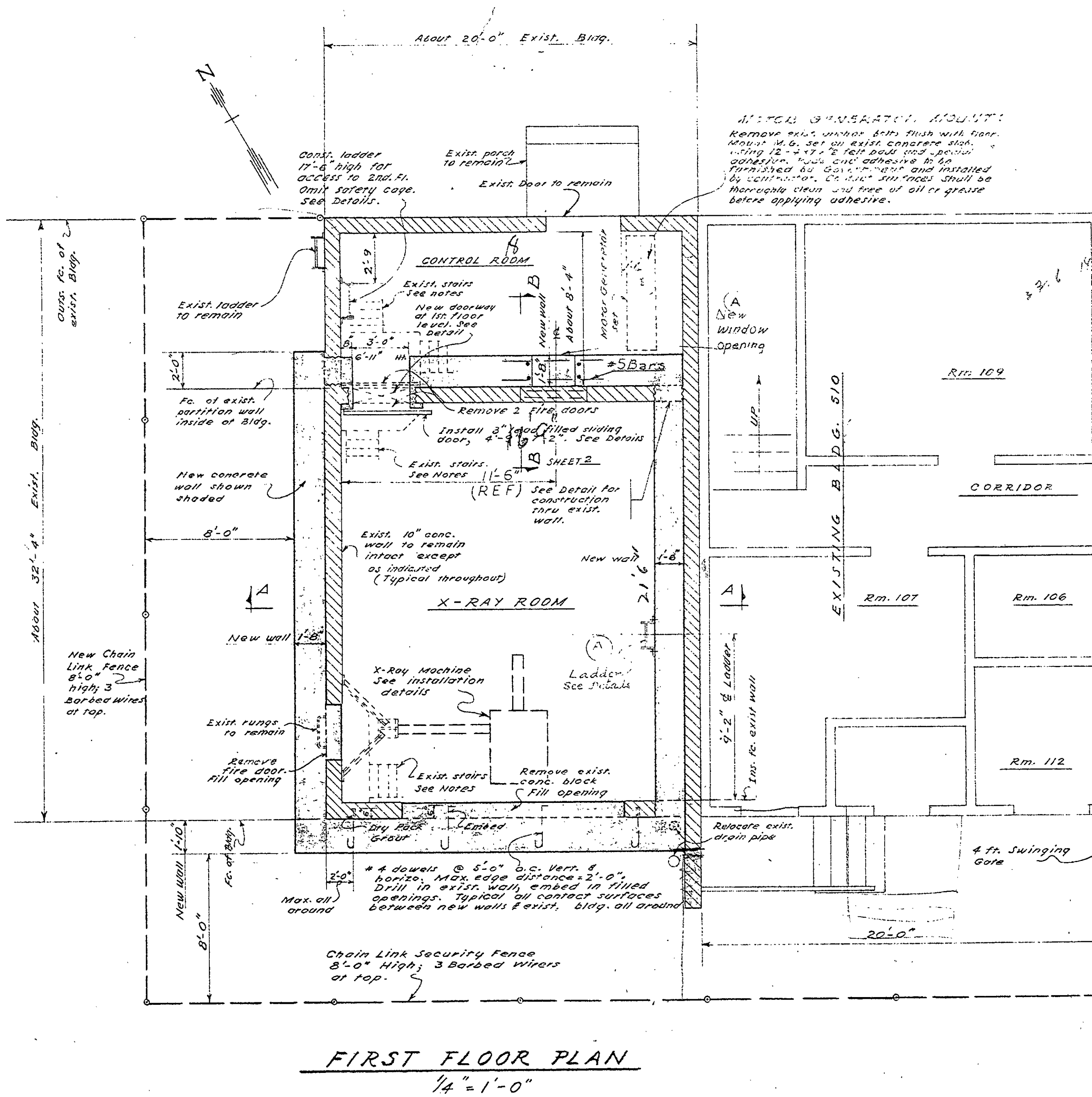
Contaminated Media:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: Moderate

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: Low

Recommended Actions: Class 1 Scoping Survey of site and any remaining drainage system.



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8 0 8

Scale in Feet

Notes:

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San Francisco CA
Historical Radiological Assessment

May, 2003

Figure 8.3.5.9 FP
Bldg. 510A Floor Plan

8.3.5.10 Former Building 517 Site

Site Description: The original Building 517 measured approximately 50 feet by 50 feet. A site plan is provided in Figure 8.3.5.3 above.

Former Uses: Former Brig and NRDL Cobalt Animal Irradiation Facility **(HRA-136; HRA-232)**.

Current Uses: Demolished.

Radionuclides of Concern: Co-60, Cs-137, and Sr-90.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Class 3 survey complete. No readings exceeding release limits.

1996 Phase III investigations. Survey and soil sampling. Anomalous count rates. Further investigation recommended.

1978 RASO scoping survey.

1970 AEC survey for clearance January 1970.

Contamination Potential: Likely.

Contaminated Media:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: Moderate

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: Low

Recommended Actions: Class 1 Characterization Survey of site and remaining drainage systems.

8.3.5.11 Former Building 520 Site

Site Description: The original Building 520 was irregular in construction and measured approximately 7,040 square feet at its foundation. A site plan is provided in Figure 8.3.5.3 above.

Former Uses: Shipyard Dental Clinic and NRDL Administrative Offices **(HRA-448, p 6; HRA-1327 Encl 1, p 2)**.

Current Uses: Demolished.

Radionuclides of Concern: Cs-137, Ra-226, and Sr-90.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Radium contamination found near foundation.

Contamination Potential: Known-Continued Access; contamination is likely in drain system piping based on radium contamination found immediately adjacent to building foundation.

Contaminated Media:

Surface Soil: Moderate
Subsurface Soil: Moderate
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: Moderate

Potential Migration Pathways:

Surface Soil: Moderate
Subsurface Soil: Moderate
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: Low

Recommended Actions: Phase V Class 3 survey data being reviewed. Class 1 characterization survey for drain system and building site.

8.3.5.12 Building 521

Site Description: Building 521 is constructed of concrete and measures approximately 7,040 square feet at its foundation. A building site plan is provided in Figure 8.3.5.3 above.

Former Uses: Power Plant and South Area. This is one of two suspected sites of fuel oil burning from three OPERATION CROSSROADS target ships.

Current Uses: Unoccupied.

Radionuclides of Concern: Cs-137, Pu-239, and Sr-90.

Previous Radiological Investigations: None.

Contamination Potential: Unlikely.

Contaminated Media:

Surface Soil: Low
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Scoping Survey.

8.3.5.13 Former Building 529 Site

Site Description: The original Building 529 measured approximately 16 feet by 20 feet. It included an underground isotope storage vault and waste sump. A site plan is provided in Figure 8.3.5.3 above, a floor plan is provided in Figure 8.3.5.13FP, and a plot plan is provided in Figure 8.3.5.13PP.

Former Uses: NRDL Isotope Storage Facility (Vault) **(HRA-147; HRA-339; HRA-412)** and Neutron Generator **(HRA-289; HRA-2772, p 13)**. When the building was renovated for installation of the accelerator, the vault was filled with compacted sand and capped with 8 inches of concrete.

Current Uses: Demolished. Foundation, underground isotope vault, and drainage system remain.

Radionuclides of Concern: Cs-137, H-3, Ra-226, and Sr-90.

Previous Radiological Investigations:

2001 NWT Phase V investigations. Contaminated underground piping found.

1996 PRC Phase III investigations. Survey and soil sampling. Identified potential buried point source. Recommended investigation and removal.

1978 RASO survey (HRA-600, p 2).Reported less than MDA of 64 dpm.

1969 NRDL survey. No radiation detected in building.

1969 AEC survey. Final AEC clearance given 24 December 1969.

Contamination Potential: Known-Continued Access.

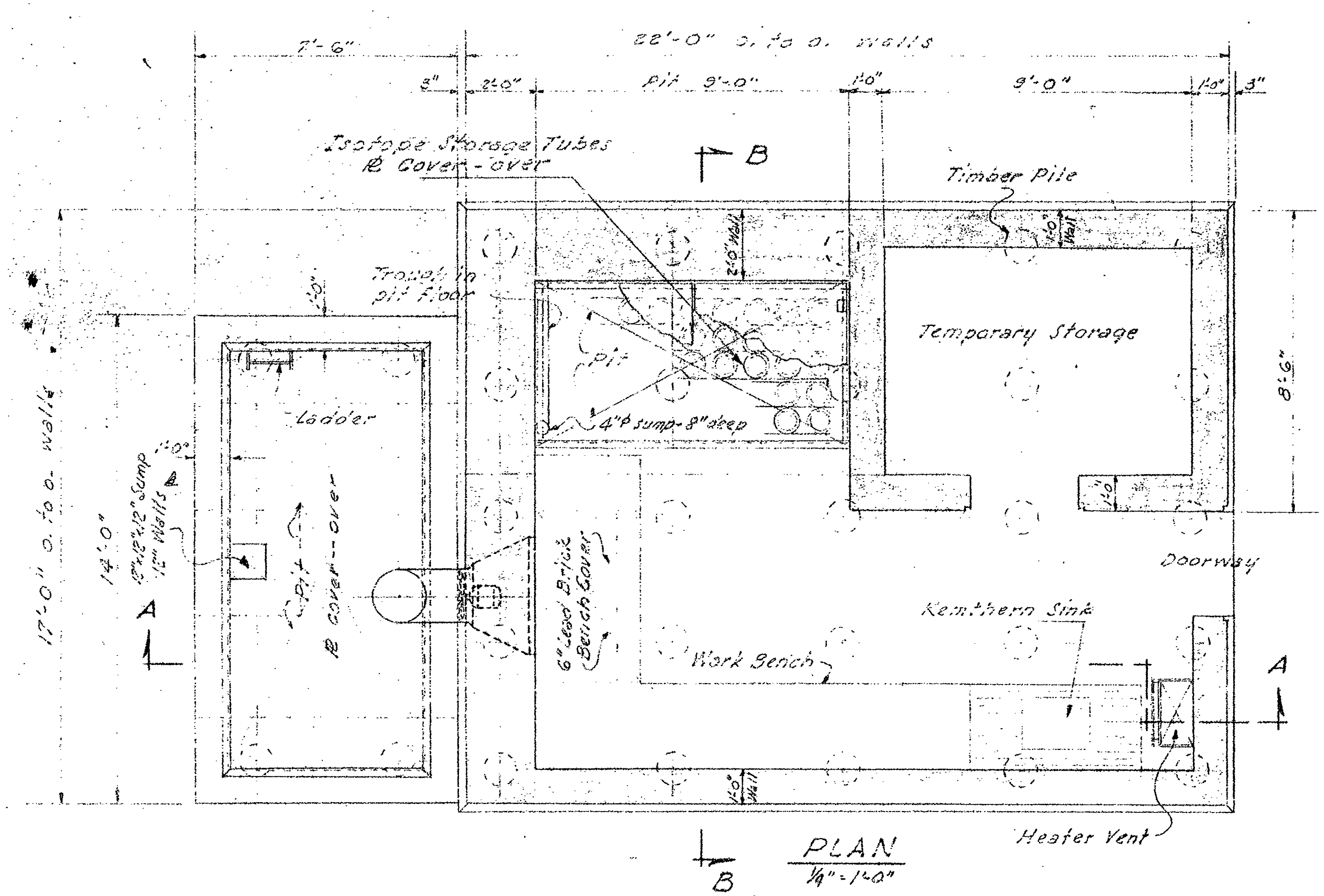
Contaminated Media:

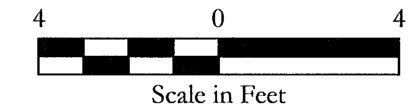
Surface Soil: Moderate
Subsurface Soil: Moderate
Surface Water: None
Groundwater: None
Air: None
Structures: Moderate (underground vault)
Drainage Systems: High

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Moderate

Recommended Actions: Review Phase V Class 3 Survey Report. Additional Class 1 scoping survey based on historical information indicating underground isotope storage vault sealed in place and contaminated found in drainage system.





Notes:

Background image per Map ID 266.

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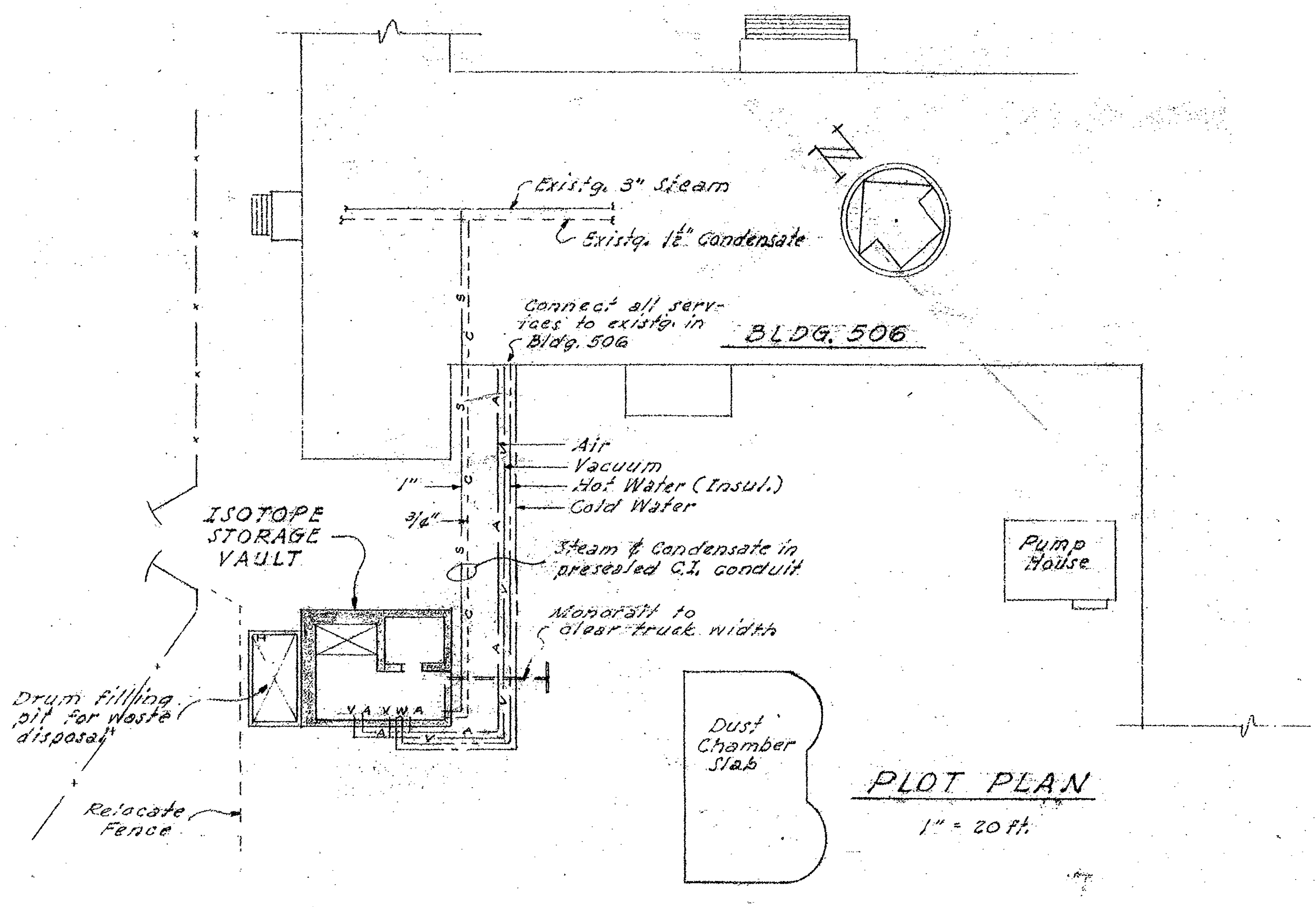
Figure 8.3.5.13FP
Building 529 - Floor Plan



Notes:

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Figure 8.3.5.13PP
Building 529 - Plot Plan

8.3.5.14 Former Building 701 Site

Site Description: The original Building 701 measured approximately 50 feet by 110 feet. A site plan is provided in Figure 8.3.5.14.

Former Uses: Storage building that NRDL requested for "temporary" (120 days) storage of samples in 1947 **(HRA-1752, p 3)**. Building still in process of transfer to HPS in 1950 **(HRA-1327 Encl 1, p 3)**. Still listed as used by NRDL in 1954 **(HRA-448, p 6)**.

Current Uses: Demolished.

Radionuclides of Concern: Cs-137, Pu-239, Ra-226, and Sr-90.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Survey complete.

1992 PRC Phase I survey. No anomalies noted.

Contamination Potential: Unlikely.

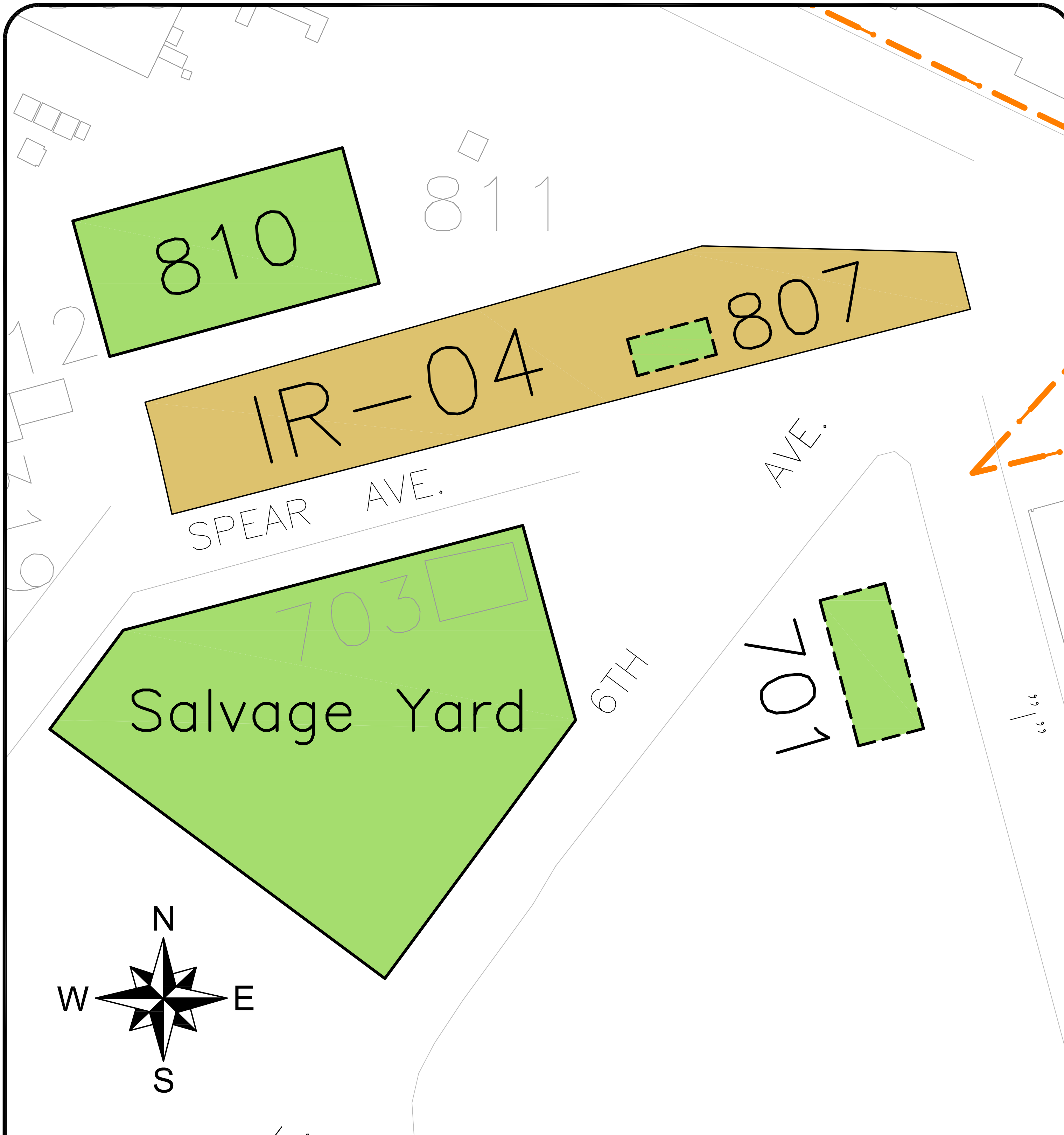
Contaminated Media:

Surface Soil: Low
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Recommended Actions: Review Final Status Survey Report.



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100 0 100

Scale in Feet

Impacted Site with Designation

Impacted Site with Designation (Demolished)

Impacted IR Site w/ Designation

Non - Impacted Building

Non-Impacted Building (Demolished)

Topographic Feature

Parcel Boundary

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

Bldg. 701, 807 & 810 Site Plan

January, 2004

Figure 8.3.5.14

8.3.5.15 Building 704 Radioactive Material Storage Area

Site Description: Building 704, a metal-sheathed shop building, stands as a marker for an area designated as a "Radioactive Material Storage" area on a 1949 map **(HRA-4081)**. This storage area was south of the building and adjacent to the animal pens/kennels (see Section 8.3.5.16 below). A site plan is provided in Figure 8.3.5.15.

Former Uses: Radioactive Material Storage Area.

Current Uses: Unoccupied.

Radionuclides of Concern: Cs-137, Pu-239, Ra-226, and Sr-90.

Previous Radiological Investigations: None.

Contamination Potential: Likely.

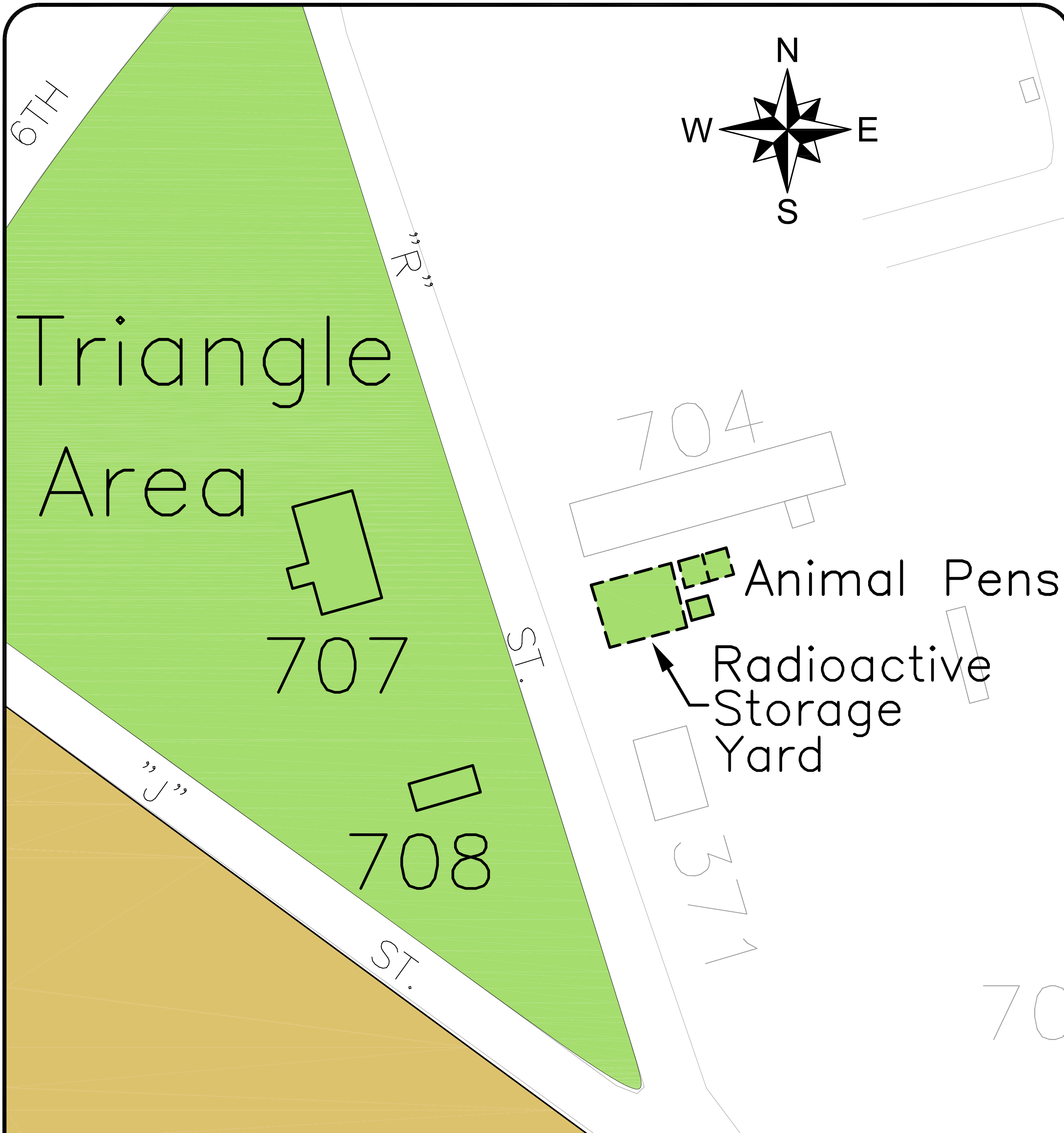
Contaminated Media:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Recommended Actions: Scoping Survey.



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100 0 100

Scale in Feet

- Impacted Site with Designation
- Impacted Site with Designation (Demolished)
- IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

Bldg. 704 Area, 707 & 708
Site Plan
January, 2004

Figure 8.3.5.15

8.3.5.16 Building 704 Area Animal Pens

Site Description: Two former animal pens were identified on a 1949 map adjacent to the Radioactive Material Storage Area south of Building 704. The animal pens measured approximately 18 feet by 20 feet and 20 feet by 12 feet **(HRA-4081)**. A site plan is provided in Figure 8.3.5.15 above.

Former Uses: Animal pens for NRDL.

Current Uses: Removed.

Radionuclides of Concern: Cs-137, Ra-226, and Sr-90,

Previous Radiological Investigations: None.

Contamination Potential: Unlikely.

Contaminated Media:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Recommended Actions: Scoping Survey.

8.3.5.17 Building 707 and Kennels

Site Description: Building 707 is irregular in construction and measures approximately 13,000 square feet, including kennels. A site plan is provided in Figure 8.3.5.15 above, and a floor plan is provided in Figure 8.3.5.17FP.

Former Uses: Research animal facility used by NRDL for animal breeding and housing **(HRA-136, p 1; HRA-147, p 1; HRA-170, p 1; HRA-1327 Encl 1, p 4)**, Waste Processing and Storage Facility **(HRA-1038 Attachment I; HRA-590, pp 3-4)**, formerly leased to Pet Express as an animal clinic.

Current Uses: Unoccupied.

Radionuclides of Concern: Cs-137, Pu-239, Ra-226, and Sr-90.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Drain piping indicates elevated Cs-137 levels.

1998 Tetra Tech EM Inc. Phase IV radiological investigation

1978 RASO surveys.

1969 NRDL disestablishment survey. Decontaminated, then it was released.

Contamination Potential: Known-Continued Access.

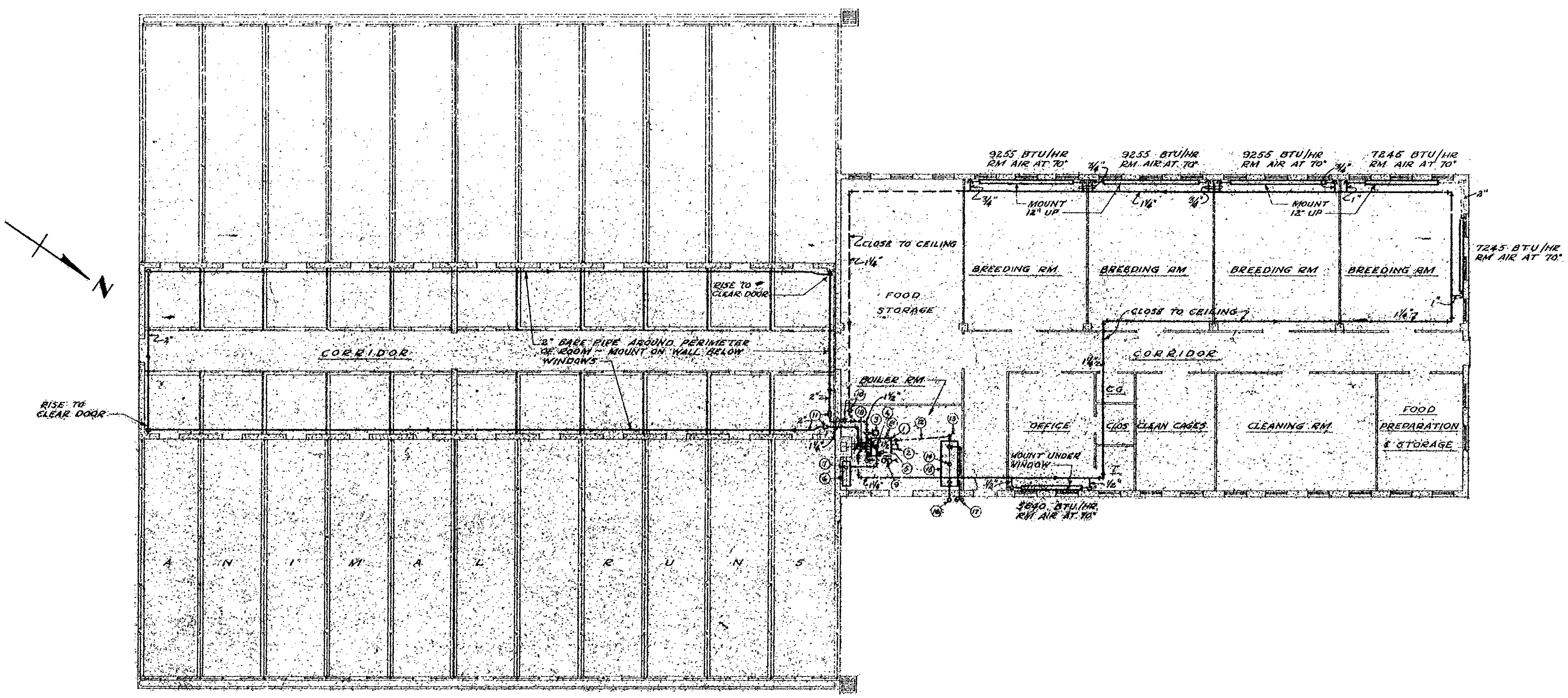
Contaminated Media:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Moderate

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Moderate

Recommended Actions: Review Phase V Report. Further Class 1 characterization surveys required based on historical information concerning drainage systems and known contamination under concrete pad.



F L O O R P L A N

SCALE: 1/8" = 1'-0"

2 0 2

Scale in Feet

Notes:

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Figure 8.3.5.17FP
Building 707 - Floor Plan

8.3.5.18 Building 707B Site

Site Description: This building is thought to have been of the same type as Building 708 (707A), a 50–by-20-foot Quonset hut.

Former Uses: NRDL Animal Colony.

Current Uses: Demolished.

Radionuclides of Concern: Cs-137, Ra-226, and Sr-90.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Survey complete as part of 707 Triangle Area.

Contamination Potential: Unlikely.

Contaminated Media:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: Low

Recommended Actions: Characterization Survey as part of 707 Triangle Area surveys.

8.3.5.19 Building 707C Site

Site Description: The former Building 707C is thought to have been of the same type as Building 708 (707A), a 50-by-20-foot Quonset hut.

Former Uses: Nuclear Weapons Test Support and Experimentation and Equipment Issue and Receiving Area **(HRA-1045)**.

Current Uses: Demolished.

Radionuclides of Concern: Cs-137, Pu-239, Ra-226, and Sr-90.

Previous Radiological Investigations: None.

Contamination Potential: Unlikely.

Contaminated Media:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Recommended Actions: Characterization Survey as part of 707 Triangle Area surveys.

8.3.5.20 Building 707 Triangle Area

707 Triangle Area in 1961

Site Description: This site is triangular in shape and measures approximately 223,000 square feet. This location is bounded by "J" Street, "I" Street, and 6th Avenue. A site plan is provided in Figure 8.3.5.20.

Former Uses: NRDL Radioactive Waste Receiving, Packaging, and Storage Area **(HRA-590, p 3)** and Suspected Septic Tank and Leach Field from Early Operations.

Current Uses: Open Land Area.

Radionuclides of Concern: Cs-137, Pu-239, Ra-226, Sr-90, and U-235.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Drain line/manhole removed. Cs-137 levels under concrete pad and in drain lines exceed release limits.

2001 NWT completes CERCLA removal actions.

1970 AEC survey for clearance January 1970 (radiation waste storage yard). Cleared for unrestricted use.

Contamination Potential: Known-Continued Access.

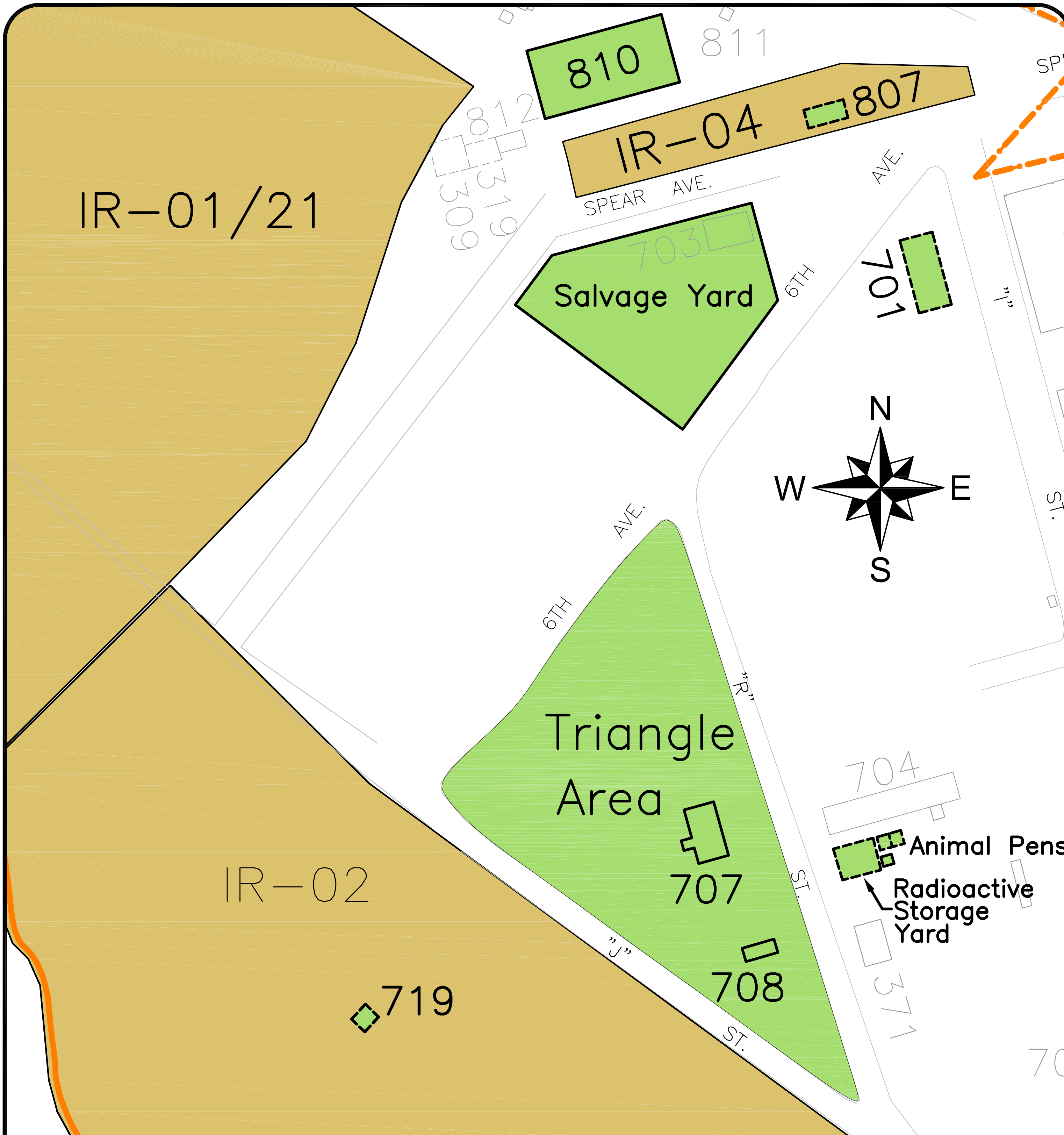
Contaminated Media:

Surface Soil: Low
Subsurface Soil: High
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: High

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Moderate
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: Moderate

Recommended Actions: Characterization Survey, remediation, and resurvey for areas exceeding release limits and complete drainage system surveys.



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200 0 200
Scale in Feet

- Impacted Site with Designation
- Impacted Site with Designation (Demolished)
- Impacted IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

Triangle Area Site Plan

January, 2004

Figure 8.3.5.20

8.3.5.21 Building 708 (also known as Building 707A)

Site Description: Building 708 is a movable Quonset hut adjacent to Building 707. It measures approximately 50 feet by 20 feet. A site plan is provided in Figure 8.3.5.15 above, and a floor plan is provided in Figure 8.3.5.21FP.

Former Uses: Research Animal Facility **(HRA-136; HRA-147)**, Bio-Medical Facility **(HRA-1327 Encl 1, p 4)**, and Animal Psychology Facility.

Current Uses: Unoccupied.

Radionuclides of Concern: Cs-137 and Sr-90.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Survey completed.

Contamination Potential: Unlikely.

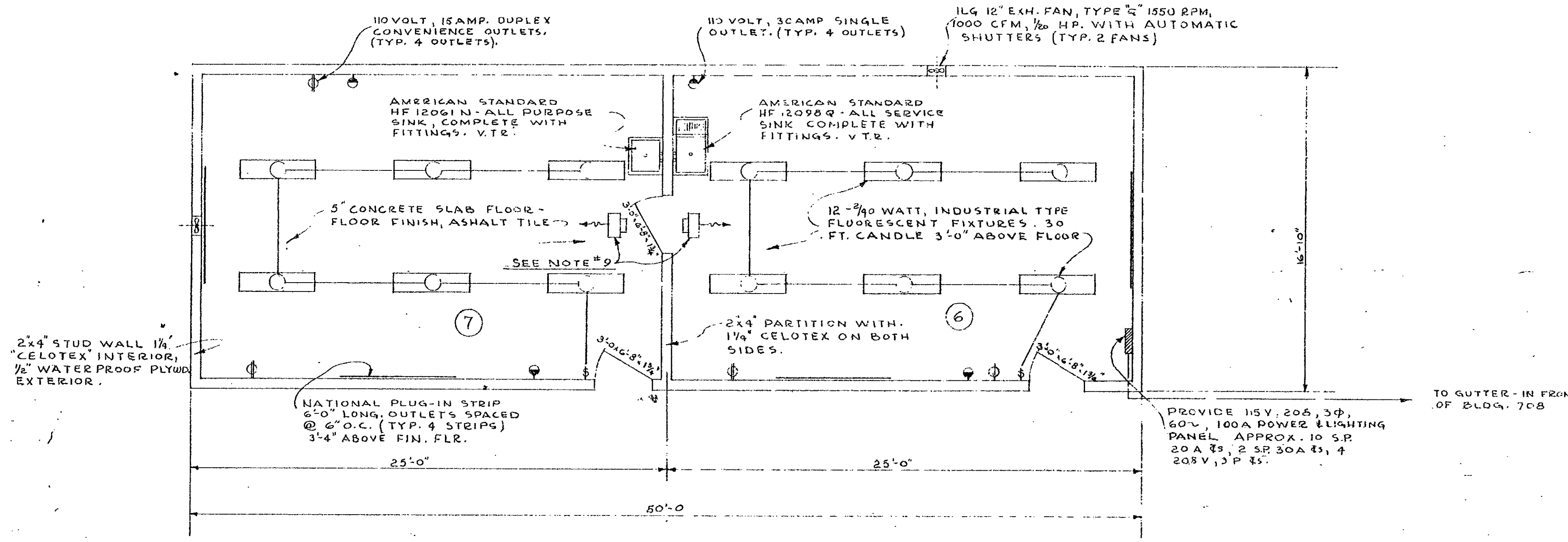
Contaminated Media:

Surface Soil: Low
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Recommended Actions: Review Final Status Survey Report.



FLOOR PLAN
SCALE: 1/4" = 1'-0"

2 0 2
Scale in Feet

Notes:

Background image per Map ID 73.

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Figure 8.3.5.21 FP
Building 708 - Floor Plan

8.3.5.22 Building 719 (also identified as S-719) Site

Site Description: The original structure measured approximately 30 feet by 24 feet. It was also identified as Building S-719. A site plan is provided as Figure 8.3.5.20 above.

Former Uses: Incinerator **(HRA-333, p 33)**. Potentially used by NRDL animal facility at Building 707 **(HRA-170 Encl 2, p 2)**.

Current Uses: Demolished.

Radionuclides of Concern: Cs-137, Ra-226, and Sr-90.

Previous Radiological Investigations: None.

Contamination Potential: Unlikely.

Contaminated Media:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Recommended Actions: Scoping Survey.

8.3.5.23 Building 807 Site

Site Description: The former Building 807 measured approximately 60 feet by 28 feet. Construction type is unknown. A building site plan is provided in Figure 8.3.5.14 above.

Former Uses: Scrap Yard Processing Shed. Possibly received scrap materials from ship decontamination.

Current Uses: Demolished.

Radionuclides of Concern: Cs-137, Ra-226, and Sr-90.

Previous Radiological Investigations: None.

Contamination Potential: Unlikely.

Contaminated Media:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Recommended Actions: Scoping Survey.

8.3.5.24 Building 810

Site Description: Building 810 is a wood-framed structure, sided in flush weatherboard. The building includes a flat roof with shallow shed-roofed elements on all sides. The monitor includes vents but no windows. At the center of the building is a large sliding industrial door with a small access window. A building site plan is provided in Figure 8.3.5.14 above.

Former Uses: LLRW and IDW Storage Location (PRC) **(HRA-1447)**, Storehouse, Paint Activities, and Paint and Oil Storage **(HRA-136, p 13)**.

Current Uses: Unoccupied.

Radionuclides of Concern: Cs-137, Ra-226, and Sr-90.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Class 3 survey of building complete. Elevated levels of Cs-137 detected in soils around loading dock.

1993 Chem Nuclear IDW drum survey. No levels exceeding background.

Contamination Potential: Known-Continued Access.

Contaminated Media:

Surface Soil: Moderate
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Moderate
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Remediate known areas of contaminated soils. Class 1 Scoping Survey of building and loading dock.

8.3.5.25 Former Shack 79 Site

Site Description: This area was identified on a list of shipyard shacks and was numbered 79. The type of construction is unknown but thought to be wood, as were other temporary structures. Dimensions were not available, and the shack is was located behind Building 506.

Former Uses: NRDL Support for Radioactive Material **(HRA-1018)**.

Current Uses: Demolished.

Radionuclides of Concern: Cs-137, Ra-226, and Sr-90.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Class 3 survey complete.

Contamination Potential: Likely.

Contaminated Media:

Surface Soil: Moderate
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Recommended Actions: Class 1 Final Status Survey based on historical documents.

8.3.5.26 Former Shack 80 (Behind Building 506) Site

Site Description: This area was identified on a list of shipyard shacks and was numbered 80. The type of construction is unknown but thought to be wood, as were other temporary structures. Dimensions were not available, and the shack was located behind Building 506.

Former Uses: NRDL Support; shack reported to have been moved from behind Building 506 to Building 704 area for "lab operations" **(HRA-1018)**.

Current Uses: Demolished.

Radionuclides of Concern: Cs-137, Ra-226, and Sr-90.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Elevated Cs-137 levels found in soil and remediated. Expanded resurvey indicated additional locations of elevated Cs-137 levels.

Contamination Potential: Known-Continued Access.

Contaminated Media:

Surface Soil: High
Subsurface Soil: Moderate
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Moderate
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Recommended Actions: Remediate known areas of contamination. Perform Class 1 Final Status Survey following remediation.

8.3.5.27 Experimental Shielding Range

Site Description: An open field area located on the extreme southwest end of IR-01/21 at HPS. The site has three parts: a fan-shaped, post-exposure reflection/refraction field, measuring 150 feet in radius; a 60–by-35-foot site designated Area A; and a 60–by-50-foot area designated Area B. Site was enclosed on the west side by a soil berm **(HRA-26, p 11)**. It was also known as the South Gate Range. A site plan is provided in Figure 8.3.5.27.

Former Uses: Experimental Shielding Range.

Current Uses: Unused Open Land.

Radionuclides of Concern: Co-60, Cs-137, and Ra-226.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Survey complete. Review pending.

Contamination Potential: Likely.

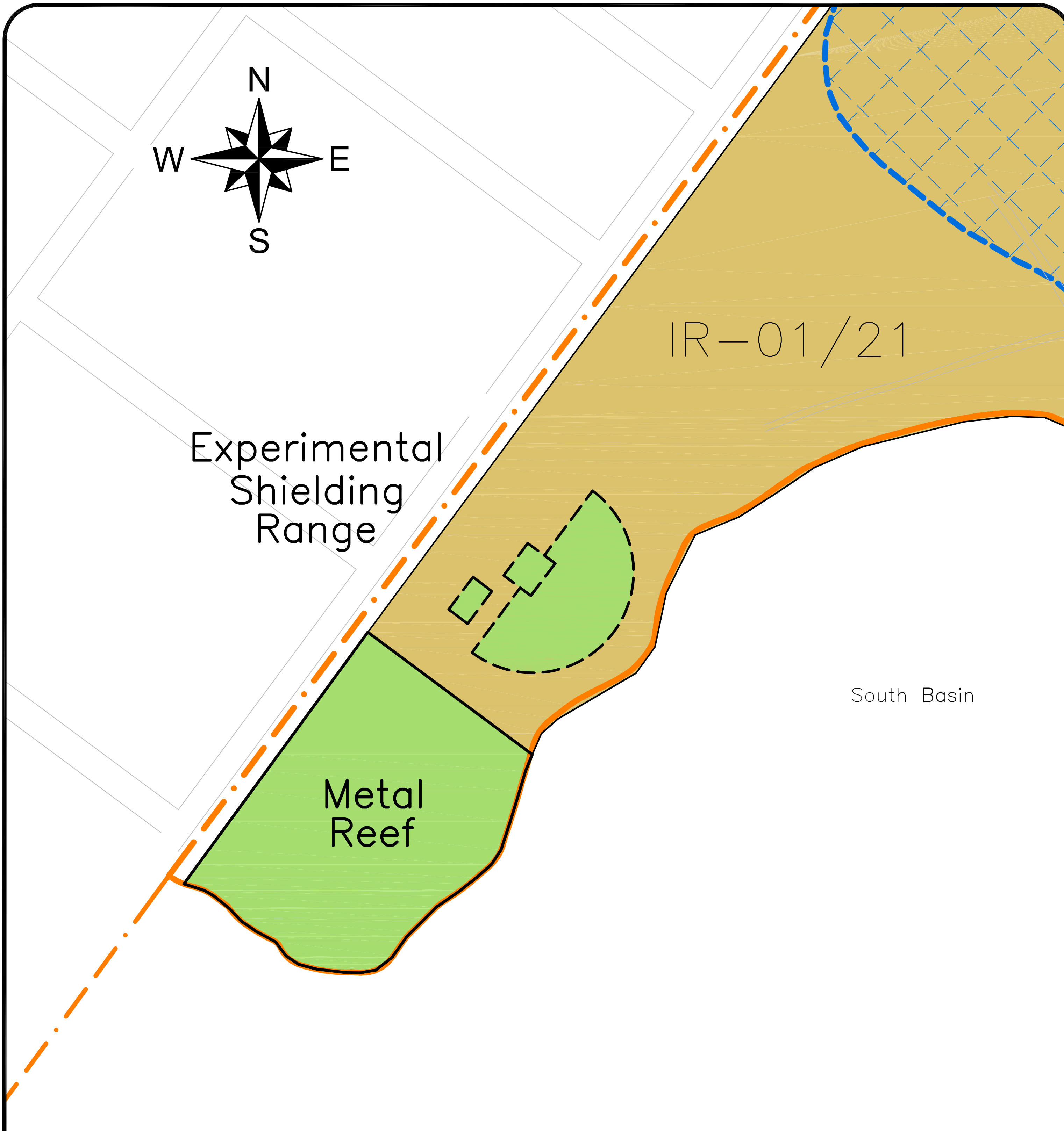
Contaminated Media:

Surface Soil: Moderate
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Recommended Actions: Review Phase V Characterization Survey results. Remediate known areas of elevated readings. Perform Final Status Survey.



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200 0 200

Scale in Feet

- Impacted Site with Designation
- Impacted Site with Designation (Demolished)
- IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary
- Landfill Area

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

Experimental Shielding Range
Site Plan
January, 2004

Figure 8.3.5.27

8.3.5.28 IR-01/21, Industrial Landfill Area

Site Description: Irregular land area, measuring approximately 1,525,000 square feet, 120 feet southeast of Building 820, 80 feet south of Building 830, 150 feet southwest of Building 810, and immediately west and adjacent to IR-02. A site plan is provided in Figure 8.3.5.28.

Former Uses: Landfill used from 1940s to 1974 for disposal of industrial and solid wastes; domestic wastes and refuse; building construction and demolition wastes; dredge spoil materials; sandblast waste; shop industrial, chemical, and solvent wastes; ship solid and liquid wastes from repair activities; and radioluminescent devices, primarily Ra-226. Potentially used for disposal of wastes from decontamination of OPERATION CROSSROADS ships.

Current Uses: Unoccupied Open Land.

Radionuclides of Concern: Cs-137, Ra-226, and Sr-90 **(HRA-1274; HRA-1447)**.

Previous Radiological Investigations:

2002-2003	NWT Phase V investigations. Gamma survey indicated several locations of elevated levels.
1993	PRC Phase II investigations. Walkover survey and radon flux testing indicated radioactive material. Excavation and survey detected 111 discrete Ra-226 point sources.
1991	PRC Phase I investigation. Anomalies found.
1988	HLA site reconnaissance survey. Survey points within background ranges.

Contamination Potential: Known-Continued Access.

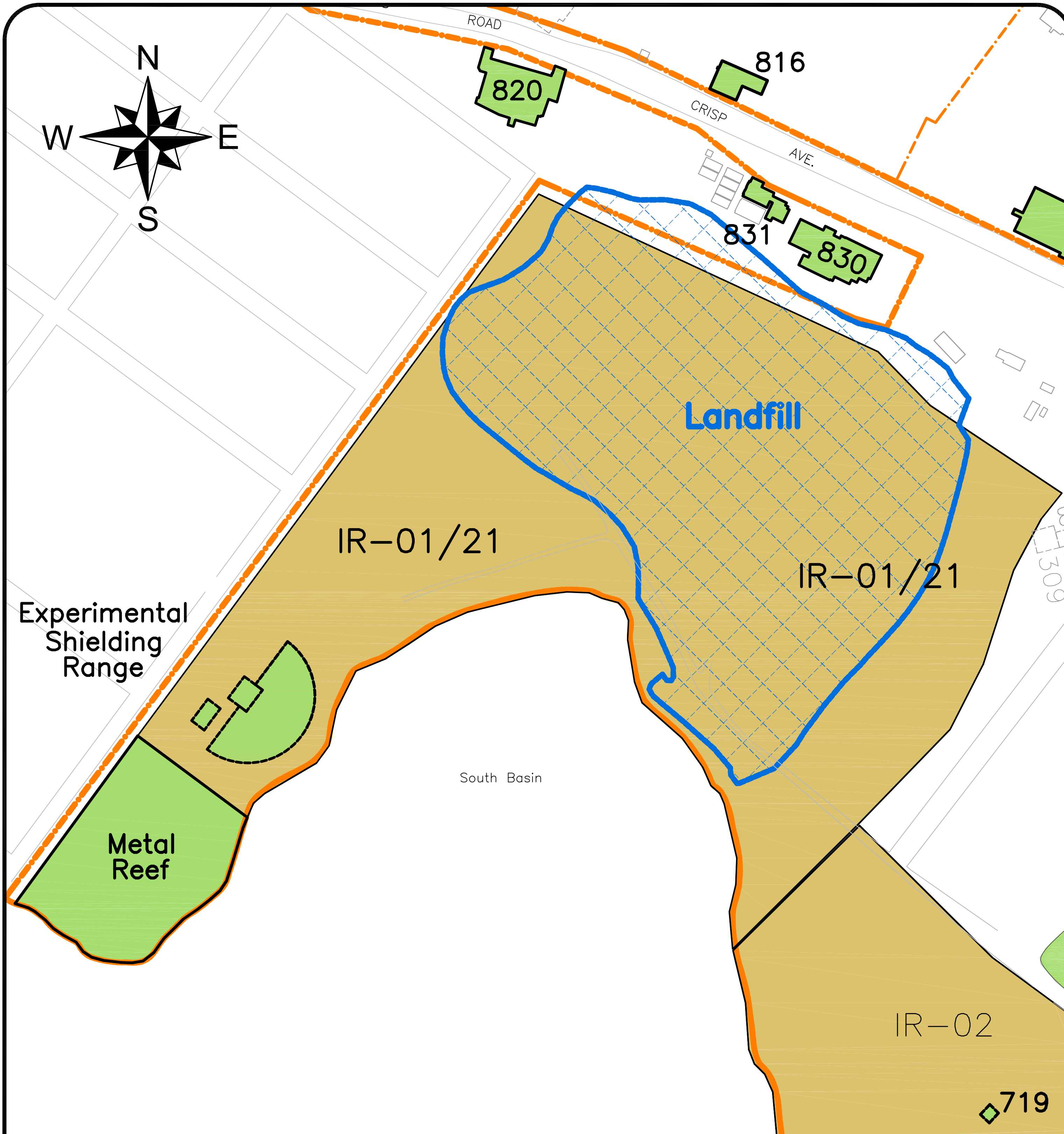
Contaminated Media:

Surface Soil: High
Subsurface Soil: High
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Moderate
Subsurface Soil: Moderate
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Recommended Actions: Review Phase V Characterization Survey results. Remediate known areas of elevated readings. Perform Final Status Survey.



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300 0 300

Scale in Feet

- Impacted Site with Designation
- Impacted Site with Designation (Demolished)
- IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary
- Landfill Area

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

IR-01 / 21 Site Plan

January, 2004

Figure 8.3.5.28

8.3.5.29 IR-02, Bay Fill Area

Site Description: An irregular land area immediately adjacent to and east of IR-01 and immediately south of "J" Street comprising approximately 2,042,650 square feet. A site plan is provided in Figure 8.3.5.29.

Former Uses: Bay Fill Area was used for disposal of assorted shipyard wastes, which included Ra-226 and Sr-90 devices. Areas known as IR-02 Northwest and Central contain an apparent concentration of the devices. Potentially used for disposal of wastes from decontamination of OPERATION CROSSROADS ships.

Current Uses: Unoccupied open land area containing the soil pile from the Bay Area Rapid Transit construction project and Building 600

Radionuclides of Concern: Cs-137, Ra-226, and Sr-90.

Previous Radiological Investigations:

1996 PRC Phase III trenching study. Identified numerous point sources below the ground surface.

1992 PRC Phase II investigations. Walkover survey and radon flux testing indicates radioactive material identified as radium point source anomalies.

1991 PRC Phase I investigation. Over 300 point sources observed.

1988 HLA site reconnaissance survey. Gamma readings exceeding background observed.

Contamination Potential: Known-Continued Access.

Contaminated Media:

Surface Soil: High
Subsurface Soil: High
Surface Water: None
Groundwater: Low
Air: None
Structures: None
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Moderate
Subsurface Soil: Moderate
Surface Water: None
Groundwater: Low
Air: None
Structures: None
Drainage Systems: None

Recommended Actions: Characterization Survey. Remediate known areas of elevated readings. Perform Final Status Survey.

500 0 500

Scale in Feet

- Impacted Site with Designation
- Impacted Site with Designation (Demolished)
- IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary
- Landfill Area

Hunters Point Naval Shipyard
San Francisco CA

Historical Radiological Assessment

IR-02 & IR-03 Site Plan

January, 2004

Figure 8.3.5.29

8.3.5.30 IR-03, Former Oil Reclamation Plant Area

Site Description: An irregular-shaped property, measuring approximately 45,000 square feet, located inside of IR-02. A site plan is provided in Figure 8.3.5.29 above.

Former Uses: HPS Fuel Oil Reclaiming Plant **(HRA-4755)**. Possible area for disposal of assorted shipyard wastes, which may have included Ra-226 and Sr-90 devices, and oil.

Current Uses: Uninhabited Open Area.

Radionuclides of Concern: Cs-137, Ra-226, and Sr-90.

Previous Radiological Investigations: None.

Contamination Potential: Likely.

Contaminated Media:

Surface Soil: Moderate
Subsurface Soil: Moderate
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Recommended Actions: Scoping Survey.

8.3.5.31 IR-04, Former Scrap Yard

Site Description: An irregular property, measuring approximately 100 feet by 600 feet, bounded by Spear Avenue to the east and south, Building 812 access road to the west, and Building 810 to the north. A site plan is provided in Figure 8.3.5.20 above.

Former Uses: Post-disassembly area for metals, equipment, and other unusable items from the Salvage Yard that could have contained Ra-226 devices and other contaminants **(HRA-523)**.

Current Uses: Asphalt and Railroad Track Open Area.

Radionuclides of Concern: Cs-137, Ra-226, and Sr-90.

Previous Radiological Investigations:

2001 NWT Phase V investigations. Gamma survey and sampling indicated several locations containing elevated levels of Cs-137 and Ra-226. Site boundary expanded following surveys as contamination was found on the boundary. Areas remediated and resurveyed. Additional contamination found.

Contamination Potential: Known-Continued Access.

Contaminated Media:

Surface Soil: High
Subsurface Soil: Moderate
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Moderate
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Recommended Actions: Review Phase V Survey Report. Further Characterization Surveys.

8.3.5.32 Former Salvage Yard

Site Description: An irregular pentagonal-shaped property, measuring approximately 75,000 square feet, bounded by Spear Avenue to the north and 6th Avenue to the east. It is immediately southwest of the former Building 702 site. A site plan is provided in Figure 8.3.5.20 above.

Former Uses: Pre-disposal disassembly area for metals, equipment, and other reusable items that could have contained Ra-226 devices and other contaminants **(HRA-523)**.

Current Uses: Unoccupied.

Radionuclides of Concern: Cs-137, Ra-226, and Sr-90.

Previous Radiological Investigations: None.

Contamination Potential: Likely.

Contaminated Media:

Surface Soil: Moderate
Subsurface Soil: Moderate
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Recommended Actions: Scoping Survey.

8.3.5.33 Parcel E Shoreline

Mid-Point of Shoreline at Low Tide

Metal Reef Area on the Southeast Shoreline

Site Description: Approximately 1.5 miles of shoreline along the Bay, starting at the southeast corner (near Berth 36) to the HPS property line in the southwest corner of IR-01/21. A site plan is provided as Figure 8.3.5.33.

Former Uses: Debris Disposal.

Current Uses: Open Land Area Bordering the Bay.

Radionuclides of Concern: Cs-137, Ra-226, and Sr-90.

Previous Radiological Investigations:

2001 NWT interim investigations. Gamma scan of shoreline found several areas of elevated levels. Analysis indicated Ra-226 as contaminant.

Contamination Potential: Known-Continued Access.

Contaminated Media:

Surface Soil: High
Subsurface Soil: Moderate
Surface Water: Low
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Moderate
Subsurface Soil: Moderate
Surface Water: Low
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Recommended Actions: Remediation and Characterization Survey.

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1000 0 1000

Scale in Feet

- Impacted Site with Designation
- Impacted Site with Designation (Demolished)
- IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary
- Landfill Area

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

Parcel E Shoreline Site Plan

January, 2004

Figure 8.3.5.33

8.3.6 Base-Wide Impacted Areas

8.3.6.1 Storm Drain Lines

Site Description: Standard concrete lines for transfer of storm water runoff to the Bay. A site plan is provided in Figure 8.3.6.1. This system was originally designed and built in the 1940s as a combined sanitary and storm sewer system, using the same conveyance piping and 40 separate discharge outfalls into the Bay. This combined system grew in sections from the 1940s to its maximum size in 1958, when it underwent the first in a series of separation projects. In 1973, the second segregation project was undertaken. This project removed some of the storm water outfalls from the South Basin Area, just offshore from the Parcel E shoreline. In 1976, the last of the separation projects was performed. This project consisted of the installation of additional dedicated sanitary sewer piping. Complete separation of the combined systems was never achieved.

Former Uses: Combined Storm and Sanitary Sewer Drains. Due to the nature of the separation process, radiological contamination from the same source could have impacted the piping and other components of both systems.

Current Uses: Storm Drains.

Radionuclides of Concern: Cs-137, Ra-226, and Sr-90.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Gamma surveys of manholes on Cochrane Street and between Buildings 364 and 365. Cs-137 levels exceeding release limits found.

2001 NWT Phase V investigations. Gamma surveys and manhole sampling confirm Cs-137 from Building 351A in Cochrane Street sanitary drains. Sanitary drains from Buildings 364 and 365 show Cs-137 exceeding release limits.

1996 PRC – through visual inspections and instrument readings, this system does not pose a risk to human health or the environment.

Contamination Potential: Known-Continued Access. Likely near former NRDL building locations and known in the immediate vicinity of Buildings 351A and 364.

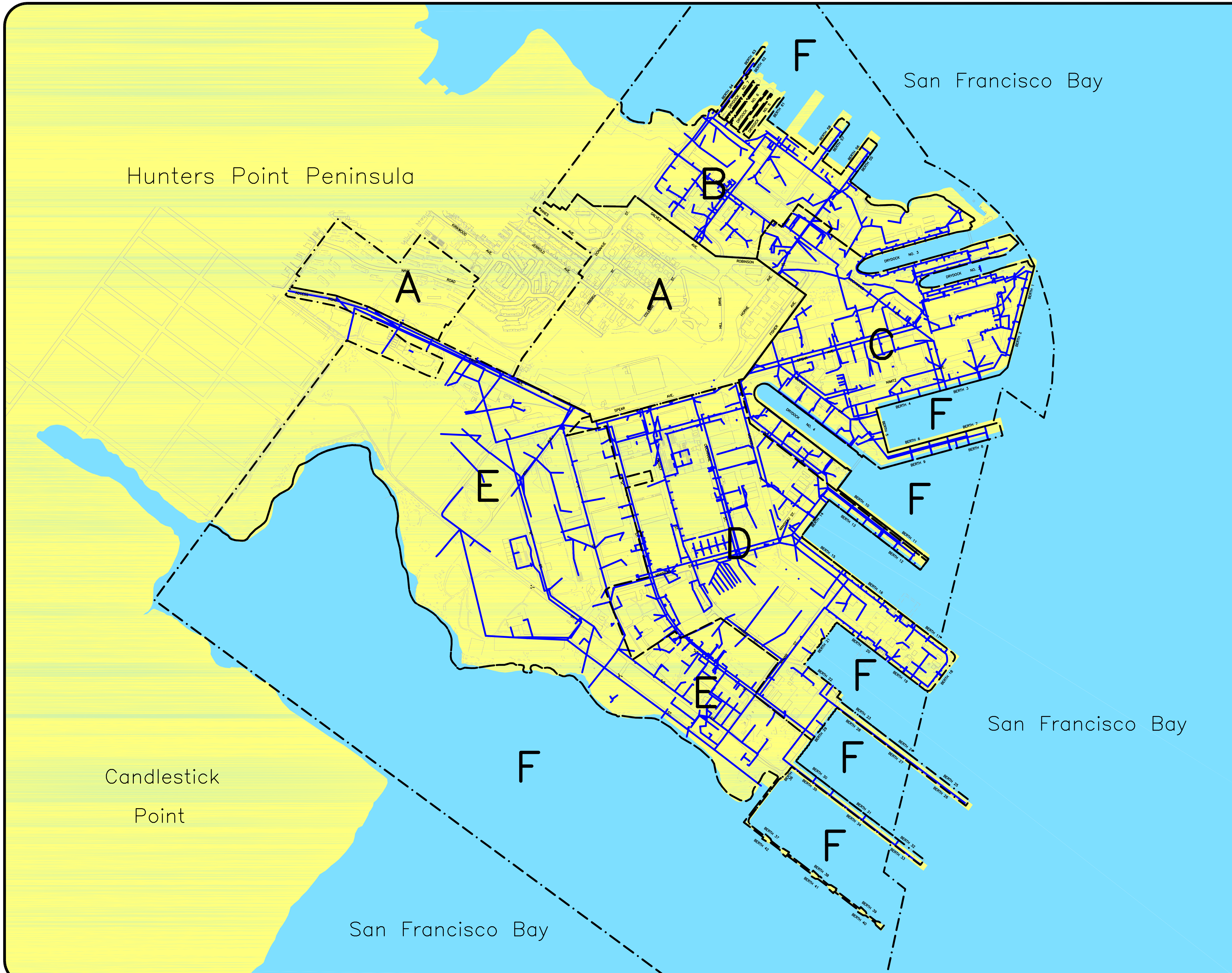
Potential Contaminated Media:

Surface Soil: None
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: High

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Moderate

Recommended Actions: Scoping and Characterization Surveys of systems associated with NRDL sites or sites associated with radium use.



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800 0 800

Scale in Feet

Notes:

Shoreline data per Aerial Photography dated 10-01-86.

1986 Shoreline

Parcel Boundary w/Designation

Shipyard Storm Drain System

Topographic Feature

Hunters Point Naval Shipyard
San Francisco CA

Historical Radiological Assessment

January, 2004

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Figure 8.3.6.1
Storm Drain System

8.3.6.2 Sanitary Sewer Lines

Site Description: Standard sewers believed to be concrete, cast iron, and terra cotta lines that run throughout the facility. Pumphouses are used to pump away from the Bay into the City of San Francisco sewer system. A site plan is provided in Figure 8.3.6.2.

The present day configuration of the sanitary and storm water sewer system is the result of an evolutionary process. This system was originally designed and built in the 1940s as a combined system, using the same conveyance piping and 40 separate discharge outfalls into the Bay.

This combined system grew in sections from the 1940s to its maximum size in 1958, when it underwent the first in a series of separation projects. The Building 819 pump station was constructed for conveyance of much of the sanitary sewage from HPS to the City of San Francisco treatment works, and separation of the systems took place in the industrial areas and the southwest area of HPS. Separation of the systems involved installation of dedicated sanitary sewer collection piping or diversion structures within the combined system piping that normally directed all combined flows through the Building 819 pump station. However, during storm events, storm water flows would overwhelm Building 819, and much of the sewage and storm water was diverted to various existing outfalls into the Bay. Twenty-eight Bay outfalls were converted to exclusive use for storm water outlets, while 12 continued to serve as combined sanitary and storm water sewer outlets. A second segregation project, undertaken in 1973, provided some additional separation of the combined systems. The last of the separation projects performed in 1976 involved the installation of additional dedicated sanitary sewer piping. Complete separation of the combined systems was never achieved.

Former Uses: Sewer System. Due to the evolutionary nature of the separation process, radiological contamination from the same source could have impacted the piping and other components of both systems.

Current Uses: Sewer System.

Radionuclides of Concern: Cs-137, Ra-226, and Sr-90.

Previous Radiological Investigations:

2002 NWT gamma survey. Sanitary lines on Cochrane Street in the vicinity of Buildings 351A and 364 show elevated levels. Radionuclide not identified.

1996 PRC – through visual inspections and instrument readings, this system does not pose a risk to human health or the environment.

Contamination Potential: Known-Continued Access. Likely in the vicinity of former NRDL buildings and known in systems immediately adjacent to Buildings 351A and 364.

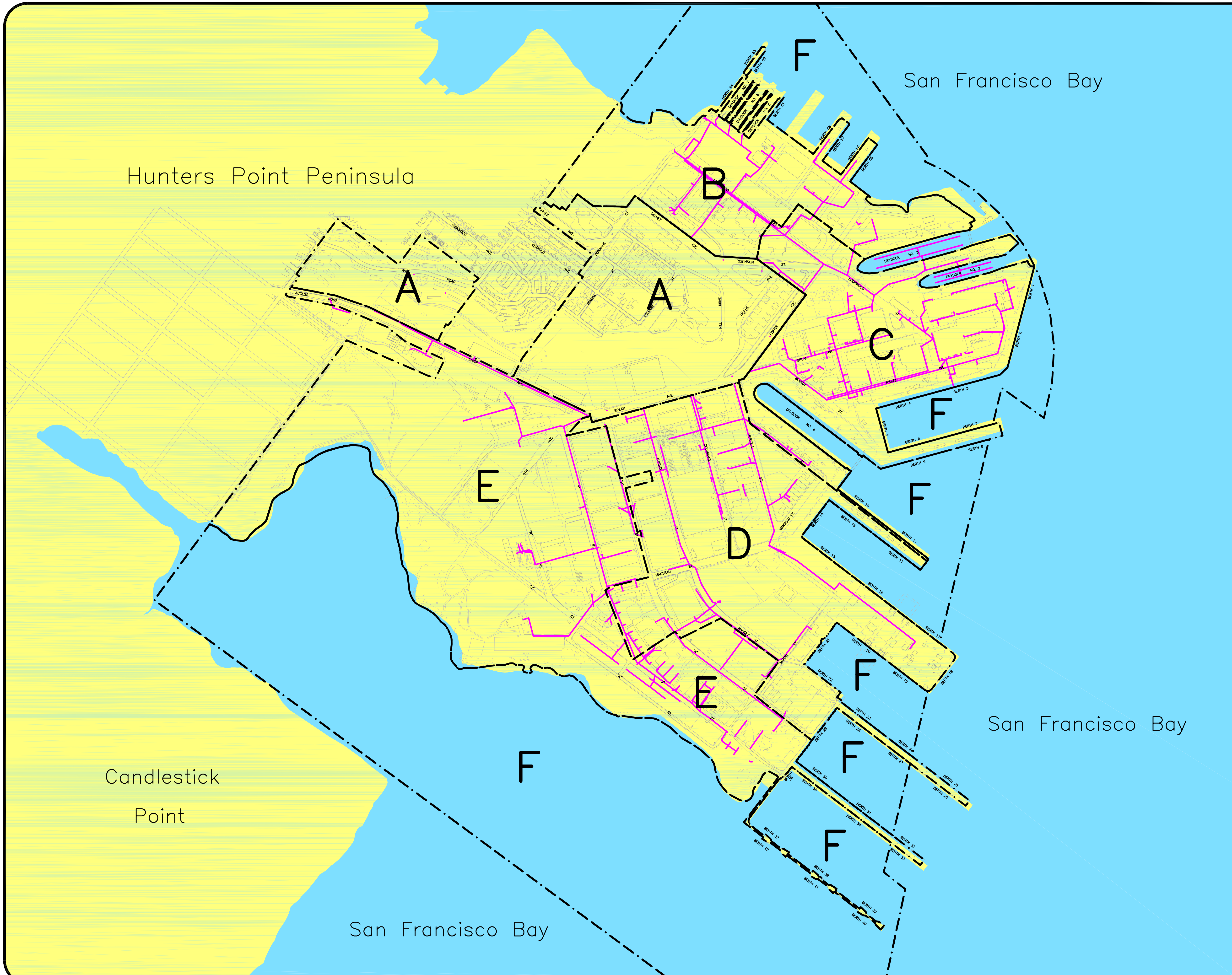
Contaminated Media:

Surface Soil: None
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: High

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Moderate

Recommended Actions: Scoping and Characterization Surveys of systems associated with NRDL sites or sites associated with radium use.



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Scale in Feet

Notes:

Shoreline data per Aerial Photography dated 10-01-86.

1986 Shoreline

Parcel Boundary w/Designation

Shipyard Sanitary Sewer System

Topographic Feature

Hunters Point Naval Shipyard
San Francisco CA

Historical Radiological Assessment

May, 2003

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Figure 8.3.6.2
Sanitary Sewer System

8.3.6.3 Septic Systems and Associated Drain Fields

Site Description: Pre-sewage system dispersion of waste products on a building-by-building basis to the surrounding sub-surface area. Drain fields will be in the immediate vicinity of the building in question.

Former Uses: Septic Systems.

Current Uses: Abandoned in Place.

Radionuclides of Concern: Cs-137, Ra-226, and Sr-90.

Previous Radiological Investigations:

2002 Phase V Investigation identified septic systems associated with 707 Triangle Area. Confirmed contamination in broken lines that could not be traced.

Contamination Potential: Likely.

Contaminated Media:

Surface Soil: None
Subsurface Soil: Moderate
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: High

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: Moderate

Recommended Actions: Scoping and Characterization Surveys of systems associated with NRDL sites.

8.3.7 Parcel F

8.3.7.1 Underwater Areas

Site Description: Underwater areas that encompass the property line of the shipyard, and waterways under ships' docking and berthing areas.

Former Uses: OPERATION CROSSROADS decontamination operations **(HRA-578)** underwater experimentation, radioactive waste disposal accidents **(HRA-261)**, contaminated water discharges **(HRA-202; HRA-1660)**, and storm and sewer discharge **(HRA-372)**.

Current Uses: Open Water.

Radionuclides of Concern: Cs-137, Pu-239, Ra-226, Sr-90, and U-235.

Previous Radiological Investigations: None for G-RAM.

Contamination Potential: Likely in areas of OPERATION CROSSROADS decontamination activities and areas containing outfall discharge from the storm drain and sanitary system.

Contaminated Media:

Surface Soil: None
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Recommended Actions: Scoping surveys in areas of OPERATION CROSSROADS decontamination activities and site outfall discharge.

8.3.7.2 All Ships' Berths

Site Description: Standard berthing spaces, including piers. A site plan is provided in Figure 8.3.7.2A (South Berths) and in Figure 8.3.7.2B (North Berths).

Former Uses: Berthing of OPERATION CROSSROADS ships, berthing of the YGN 73 (radioactive waste disposal barge), and NRDL usage (berthing of experimental barges and YAGs-39 and 40).

Current Uses: Unused.

Radionuclides of Concern: Cs-137, Pu-239, Ra-226, and Sr-90.

Previous Radiological Investigations:

2002 NWT Phase V investigations of Berths 15, 16, 17, 18, 19, and 20 at Gun Mole Pier. Areas containing Cs-137 slightly exceeding limits identified.

Contamination Potential: Unlikely.

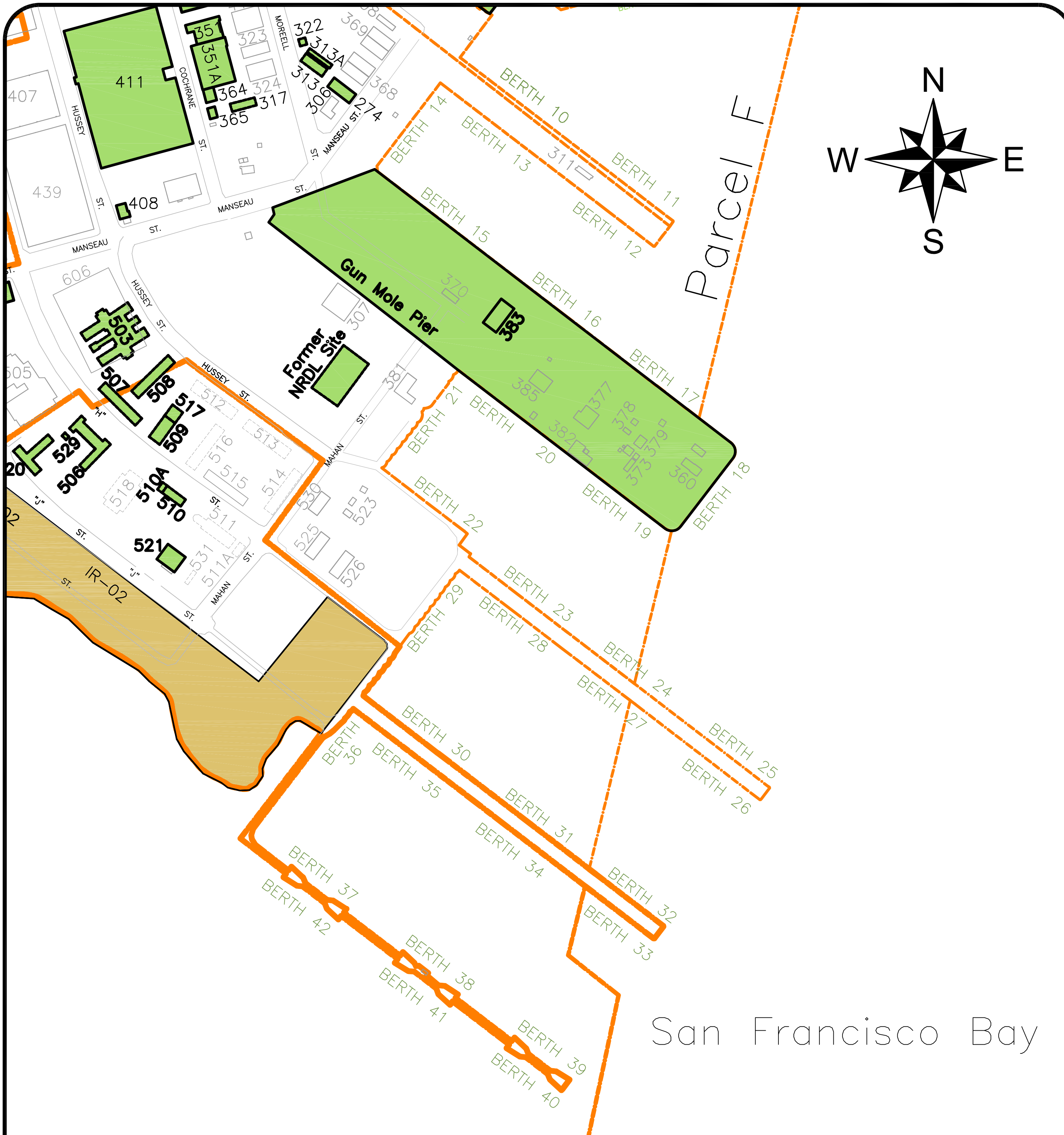
Contaminated Media:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Low
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Review Final Status Survey report for completed berths. Scoping survey for the remainder.



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500 0 500

Scale in Feet

Impacted Site with Designation
Impacted Site with Designation (Demolished)
Impacted IR Site w/ Designation
Non - Impacted Building
Non-Impacted Building (Demolished)
Topographic Feature
Parcel Boundary

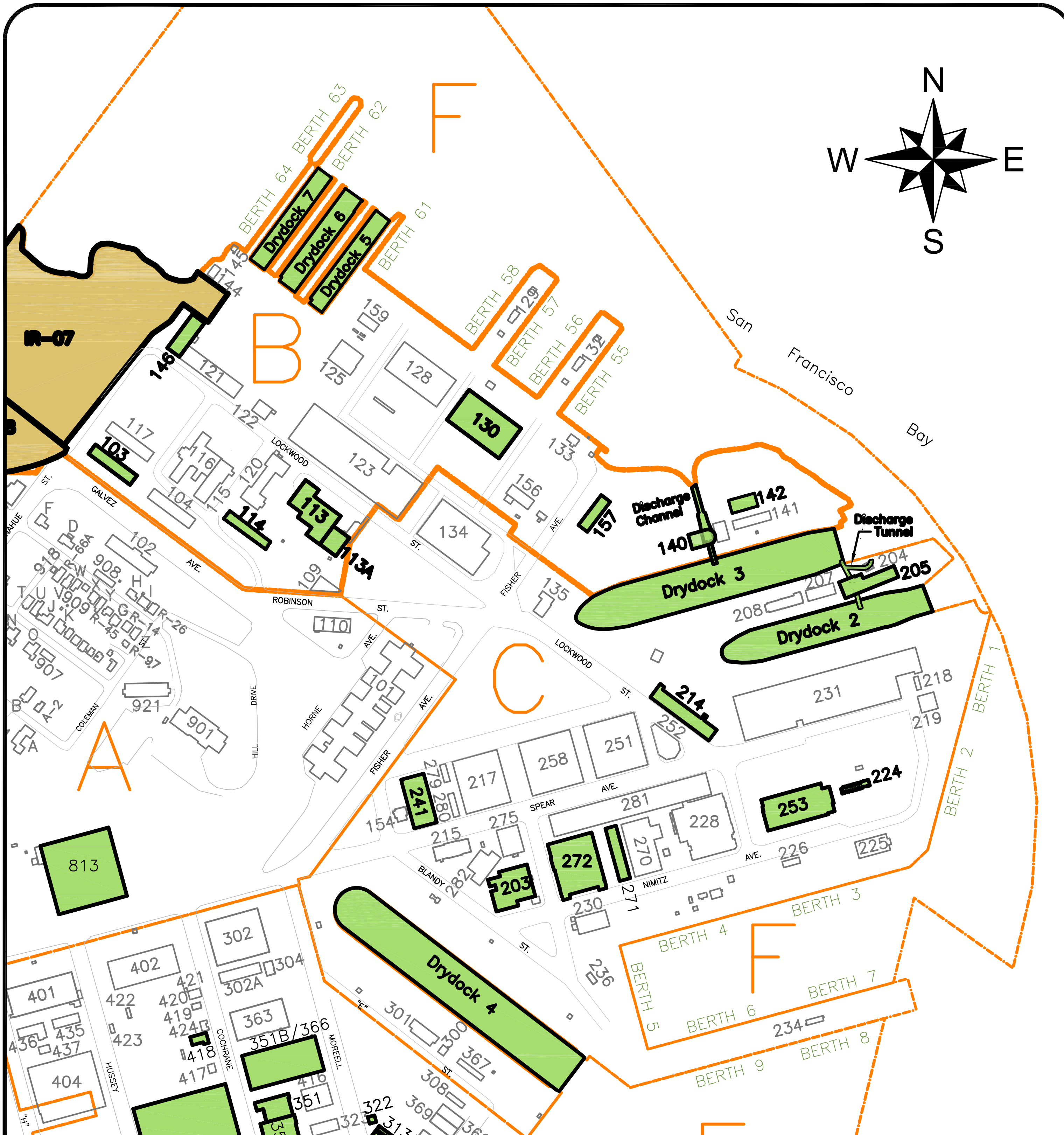
All Berths shown are Impacted

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

Ship Berths (South)

January, 2004

Figure 8.3.7.2A



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500 0 500

Scale in Feet

- Impacted Site with Designation
- Impacted Site with Designation (Demolished)
- Impacted IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary

All Berths shown are Impacted

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

Ship Berths (North)

January, 2004

Figure 8.3.7.2B

8.3.8 Off-Base Facilities Used to Support HPS

8.3.8.1 ICW 418 (W-418)

Site Description: A shallow, gable-roofed, metal warehouse building covering approximately a city block. A site plan is provided as Figure 8.3.8.1.

Former Uses: Used by NRDL as storehouse **(HRA-250)**, QARA Welding Engineering Facility (at Islais Creek), and Hydro Chemical Services, TMCM.

Current Uses: Vacant.

Radionuclides of Concern: Cs-137, Ra-226, and Sr-90.

Previous Radiological Investigations:

1970 AEC survey for clearance December 1969 (Islais Creek)

Contamination Potential: Unlikely.

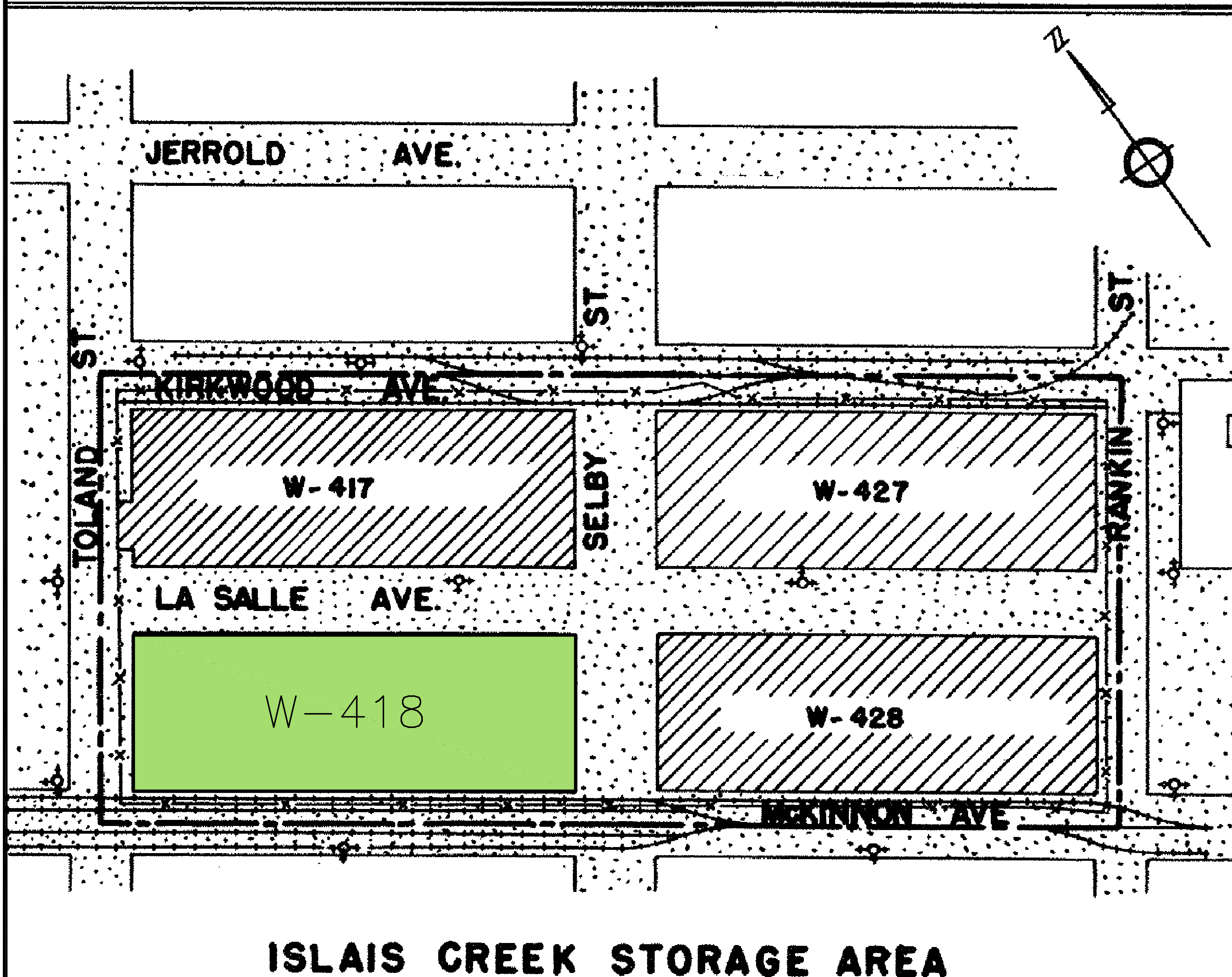
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Scoping Survey.



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Scale in Feet

- Impacted Site with Designation
- Impacted Site with Designation (Demolished)
- IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary
- Landfill Area

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

Bldg W-418 Site Plan

January, 2004

Figure 8.3.8.1

8.3.9 Formerly Used Defense Sites

8.3.9.1 Building 815

Site Description: A seven-story flat-roofed steel and concrete structure built in the early 1950s as NRDL's main research facility and headquarters **(HRA-1633; HRA-2036, p 1)**. NRDL occupied the building from 1955 **(HRA-235; HRA-2427; HRA-2466)** through its closure in 1969 **(HRA-413; HRA-2918, p 1)**. The entire building was classified as a restricted area. Generally, each floor of the facility was occupied as follows **(HRA-599, p 2; HRA-2772, pp 4-9; HRA-2910; HRA-2918, p 2; HRA-2927)**:

- Basement: Various support facilities
- First Floor: Lobby, guard office, building equipment rooms, storage rooms, and laboratories
- Second Floor: Health Physics Division, instrument repair, maintenance, and calibration facilities
- Third Floor: Administration
- Fourth Floor: Nucleonics Division laboratories and offices
- Fifth Floor: Laboratories and animal quarters and offices of the Biological and Medical (Bio-Med) Sciences Division
- Sixth Floor: Chemical Technology Division laboratory facilities
- Seventh Floor (the only floor with windows): Cafeteria and auditorium

Two underground 15,000-gallon liquid effluent holding tanks were on the outside of the west end of the building **(HRA-599, p 2; HRA-2772, p 8; HRA-4507, HRA-4508)**. A building site plan is provided as Figure 8.3.9.1.

Former Uses: Main NRDL Research Facility **(HRA-272, p 2; HRA-432; HRA-1051).**

Current Uses: Owned by Mr. Ted Lowpensky and Occupied by Filesafe, Inc.

Radionuclides of Concern: All listed in Table 4-2.

Previous Radiological Investigations:

1979 RASO resurvey of Building 815. Decontamination followed by survey. All areas surveyed met revised release criteria of the period.

1978 RASO survey of Building 815. Building contained isolated hot spots based on revised release criteria.

1978 LFE survey. Noted several locations exceeding revised release limits.

1970 AEC survey. Met release criteria for the period.

1969 NRDL disestablishment survey. Decontaminated and surveyed. Met release criteria for the period.

Contamination Potential: Likely (due to more stringent release criteria and better instrumentation).

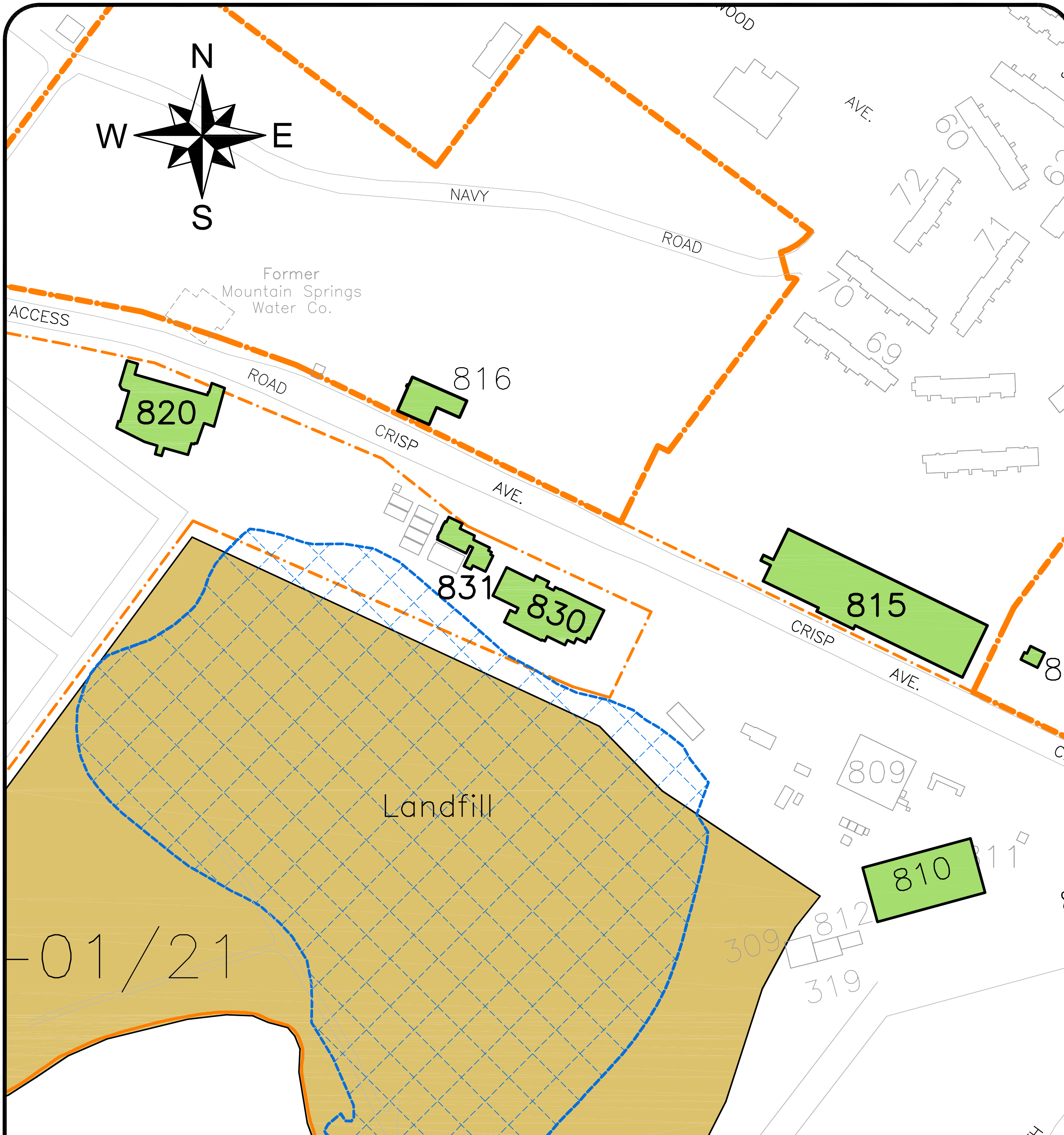
Contaminated Media:

Surface Soil: Low
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Moderate
Drainage Systems: Low

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Recommended Actions: Scoping Survey.



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250 0 250
Scale in Feet

- Impacted Site with Designation
- Impacted Site with Designation (Demolished)
- Impacted IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary
- Landfill Area

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological Assessment

FUDS Buildings Site Plan

January, 2004

Figure 8.3.9.1

8.3.9.2 Building 820

Site Description: An irregular-shaped, reinforced concrete building, measuring approximately 19,840 square feet at its foundation. No longer considered Navy property. A building site plan is provided as Figure 8.3.9.1 above.

Former Uses: Machine shop for cyclotron construction **(HRA-555, p 7)** and NRDL cyclotron laboratory **(HRA-4667)**.

Current Uses: Owned by Mr. Ted Lowpensky. Used as Lowpensky Moulding, a wood moulding shop.

Radionuclides of Concern: None.

Previous Radiological Investigations:

1969 Final AEC clearance not needed (housed the never-fully operational Cyclotron).

Contamination Potential: Unlikely.

Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Scoping Survey.

8.3.9.3 Building 830

Site Description: A pre-engineered, large, irregular-shaped metal shed, measuring approximately 16,500 square feet at its foundation. No longer considered Navy property. A building site plan is provided in Figure 8.3.9.1 above. A floor plan is in Reference HRA-4733.

Former Uses: NRDL research animal breeding facilities and kennels **(HRA-557, p 10 and 2 following pages)**.

Current Uses: Sold to the University of California at San Francisco.

Radionuclides of Concern: None.

Previous Radiological Investigations: None.

Contamination Potential: Unlikely.

Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Scoping Survey.

8.3.9.4 Building 831

Site Description: The building is irregular in construction and measures 4,400 square feet at its foundation. No longer considered Navy property. A building site plan is provided in Figure 8.3.9.1 above.

Former Uses: Research Animal Facility **(HRA-333, p 31; HRA-2927, p 16)**.

Current Uses: Sold to University of California at San Francisco.

Radionuclides of Concern: None.

Previous Radiological Investigations: None.

Contamination Potential: Unlikely.

Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Scoping Survey.

SECTION 8
TABLES

TABLE 8-1
IMPACTED SITES AT HPS
CURRENT USES

Building/ Site No.	Parcel	Former Use	Current Status
813	A	General Warehouse and Offices, Supply Storehouse, Disaster Control Center Storehouse and Offices	Unoccupied
816	A	Two-meV Van de Graaff Neutron Generator, Chemical-Biological Laboratory, Offices, and Machine Shop	Unoccupied
819	A	Sewer Pump Station A	In use
821	A	One-meV X-Ray Generator and X-Ray Laboratory	Unoccupied
103	B	Submarine Barracks (1951); personnel decontamination center for OPERATION CROSSROADS personnel	Navy leased to San Francisco Redevelopment Agency and used by artists from The Point
113	B	Tug Maintenance, Salvage Diver Facility, Tug Maintenance Facility, Torpedo Storage and Overhaul (1951-1964), and Sample Storage from Atomic Weapons Tests	San Francisco Police Department storage
113A	B	Torpedo Storage Building, NDT Facility (Radiography), Machine and Maintenance Shop, Shipyard Analytical Laboratory, Radioactive Material Storage Building, Radiographer's Vault, and Waste Disposal and Storage Facility; the building was also used to store sheet lead removed from Building 364	Smith-Emery
114 Site	B	NRDL Design Branch and Technical Library (1951)	Demolished
130	B	Occupied by Protective Finishes Company (1994); PRC used the building as a LLRW (Ra-226 and IDW) storage area (1994), Shop Service (1968-1973), Pipe Fitter Shop, General Shops, Ship Repair Shop, Machine Shop, and Metal Working Shop	Environmental HAZMAT storage
140 and Discharge Channel	B	Drydock 3 Pumphouse and Discharge Channel	Unoccupied
142	B	Air Raid Shelter A, Storage, High Level Sample Counting Room, and Low Background Counting Room	Unoccupied; partially demolished
146	B	Industrial and Photo Laboratory (1951-1964), General Shops, Radioactive Waste Storage Area, Radioluminescent Device Turn-in Building, TACAN Facility, and Lead-Lined Vault for Shipyard X-Ray Sources	Unoccupied

**TABLE 8-1
IMPACTED SITES AT HPS
CURRENT USES**

Building/ Site No.	Parcel	Former Use	Current Status
157	B	QARA Industrial Laboratory, NDT, Sound Laboratory, Testing Center for Metals (radiography), and Metal Shop	Unoccupied
Drydock 5	B	Decontamination of Ships from OPERATION CROSSROADS and Ship Repair (Submarines)	Unused
Drydock 6	B	Decontamination Drydock for Ships from OPERATION CROSSROADS and Ship Repair (Submarines)	Unused
Drydock 7	B	Possible Decontamination Drydock for Ships from OPERATION CROSSROADS and Ship Repair (Submarines)	Unused
IR-07	B	Flat Land Area Built by the Navy to Support Conventional (non-nuclear) Submarine Maintenance, and Potential Disposal of Waste from Decontamination of Ships from OPERATION CROSSROADS.	Undeveloped open land
IR-18	B	Flat Land Area built by the Navy, Waste Oil Disposal Area, Potentially Used for Disposal of OPERATION CROSSROADS Decontamination Materials, and Recreational Vehicle Camping and Parking	Undeveloped open land
203	C	Power Plant; this is one of two sites suspected of burning fuel oil from three OPERATION CROSSROADS target ships	Unoccupied
205 and Discharge Tunnel	C	Pumphouse and Discharge Tunnel for Drydock 2	Unoccupied
211	C	Machinery and Electrical Test/Repair Shop and Contractor LLRW Storage Site	Unoccupied
214	C	Combat Weapons Systems Office, Administrative Offices, Accounting and Bond Office, Triple A Office Space, and NRDL Health Physics Counting Room in Room 105	Unoccupied
224	C	Air Raid Shelter and OPERATIONS CROSSROADS and GREENHOUSE Sample Storage	Unoccupied
241	C	Forge Shop, S-23	Unoccupied

TABLE 8-1
IMPACTED SITES AT HPS
CURRENT USES

Building/ Site No.	Parcel	Former Use	Current Status
253	C	Radiography and Instrument Calibration through 1974, Gauge Shop, Electronics, Optical and Ordnance Shops, Weapons Shop, Electrical Shop, RADIAC Calibration Laboratory, Storage of Parts and Equipment from OPERATION CROSSROADS Ships, Maritime Administration Ship Parts Storage (1994), and Probable Location of Radium Paint Activities (Gauge Shop)	Unoccupied
271	C	Spray Painting, Paint Shop Annex and Equipment Storage/Barge Services Office (Navy SUPSHIP) (1994)	Unoccupied
272	C	Machine Shop, Manufacture and Repair of Machine Tools, Paint Shop Service Group Offices, Riggers Tooling Storage and Issue, Riggers and Laborers Shop, and Possible Radiography	Unoccupied
Drydock 2	C	Drydock and OPERATION CROSSROADS Ship Decontamination, Decontamination of YAG-39 and YAG-40, and Possible Removal of Radium Devices from Ships	Unused
Drydock 3	C	Drydock, OPERATION CROSSROADS Ship Decontamination, Possible Removal of Radium Devices from Ships, and Triple A	Unused
Drydock 4	C	Drydock, OPERATION CROSSROADS Ship Decontamination, Possible Removal of Radium Devices from Ships, and Triple A	Unused
274	D	Decontamination Training and Office Space	Unoccupied
313 Site	D	NRDL Instrumentation Laboratory and Stockroom and Storage	Demolished
313A Site	D	NRDL Offices, Training, and Storage	Demolished
317 Site	D	Temporary Animal Quarters for NRDL	Demolished
322 Site	D	NRDL Office (called a “shack”), NRDL Instruments Branch, North Gate Pass Office, and Field Office	Demolished
351	D	Electronics Work Area/Shop, Optical Laboratories, NRDL Materials and Accounts Division, NRDL Technical Information Division, BUMED Storeroom, NRDL Office Services Branch, NRDL Thermal Branch, Machine Shop (on first floor), NRDL Engineering Division, NRDL Library, Sampling Laboratory, General Research Laboratories, and Biological Research Laboratories	Unoccupied

TABLE 8-1
IMPACTED SITES AT HPS
CURRENT USES

Building/ Site No.	Parcel	Former Use	Current Status
351A	D	NRDL Chemical Technology Division, Headquarters Guard Post, NRDL Physical Security, NRDL Applied Research Branch, NRDL Chemical Technology Division, NRDL Administrative Offices, NRDL Nuclear and Physical Chemistry Branch, NRDL Chemical and Physics Branch, NRDL Analytical and Standards Branch, Instrument Repair Facility, Metrology Laboratory, Electronics Shop Annex, Material Storage Area, Instrument Calibration Laboratory, and Radiography Shop	Unoccupied
364	D	Animal Irradiation Facility, Liquid Radioactive Waste Collection Facility, Hot Cell, Research Animal Facility, Storage Building, Isotope Processing and Decontamination Studies, General Research Laboratory, and Young Laboratories	Unoccupied
365	D	Personnel Decontamination Facility, Change House, Storage Building, and Small Animal Facility	Unoccupied
366 (formerly 351B)	D	NRDL Instrument Calibration, NRDL Administrative Offices, NRDL Applied Research and Technical Development Branches, Administrative Offices (moved from D-19, 20, 21, in 1952), NRDL Radiological Safety Branch, NRDL Management Planning Division, NRDL Nucleonics Division, NRDL Instruments Evaluation Section, NRDL General Laboratories, NRDL Chemical Research Laboratory, Radiography Shop, Boat/Plastic Shop, Other Military/Navy Branch Project Officers Station, and NRDL Management Engineering and Comptroller Department	Leased to San Francisco Redevelopment Agency, and used by The Point (artists)
383 Area	D	Turn-In Area for Radium Devices Removed from Ships before this Building was Constructed	HPS CSO Office
408	D	Furnace/Smelter	Not used
411	D	Source Storage, Civilian Cafeteria, Radiography Shop, Shipfitters and Boilermakers Shop, and Ship Repair Shop	Eric Lansdown (The Doll House), Sierra Western Equipment
500	D	NRDL Storage, Barracks, Bachelor Officers Quarters, and NRDL Administrative Offices	Unoccupied

TABLE 8-1
IMPACTED SITES AT HPS
CURRENT USES

Building/ Site No.	Parcel	Former Use	Current Status
503 Site	D	Ships Galley and Military Support Services and NRDL Contaminated Laundry Facility	Original building demolished; current site of San Francisco Police Department training facility
Gun Mole Pier	D	Radioactive Pavement Decontamination Study, Decontamination Studies on NRDL Experimental Barge YFN-809 and on a Contaminated B-17 Aircraft, and Landing Area for NRDL Barge YFNX-16 Used as a Decontamination and Laboratory Facility. There were also decontamination facilities near Barge YFNX-16. The ex-INDEPENDENCE was berthed at the Gun Mole Pier and it was a loading point for radioactive wastes to an ocean disposal barge.	Only occupant on the pier is the HPS CSO in Building 383
NRDL Site on Mahan St	D	Unknown; Potential Storage Site of OPERATION CROSSROADS Material	Open area
406	E	Shipping, Packing, and Preserving and B&A Bodyworks and Towing.	Unoccupied
414	E	LLRW Storage Area for Remedial Investigation IDW (PRC), Public Works/Supply Storehouse, and Shaw Environmental	Shaw (Navy environmental contractor)
500 Building Series Site	E	Site of Original RADLAB/NRDL Administrative and Laboratory Facilities and Outdoor Storage	Open area
506 Site	E	Radioactive Waste Containers Stored on Pad Behind Building, NRDL Biology and Health Physics Laboratories, Animal, Nuclear and Physical Chemistry Laboratories, Radioactive Waste Storage Tank, NRDL Chemistry Laboratories, Radiochemistry Laboratory, NRDL Instrument Repair, Darkroom and Densitometer for Film Badges, Counting Rooms, Electro-Physical and Surface Chemistry Laboratories, Administrative Offices, Storerooms, Duty Watch Berthing, Personnel Decontamination, and RADLAB/NRDL Headquarters and Main Facility Prior to Move to Building 815 in 1955	Demolished
507 Site	E	NRDL Biology Laboratories, NRDL Change House and Animal Quarters, Radiological Decontamination Center, Biochemistry Branch, Physiology-Psychology Branch, and Experimental Pathology Branch	Demolished

TABLE 8-1
IMPACTED SITES AT HPS
CURRENT USES

Building/ Site No.	Parcel	Former Use	Current Status
508 Site	E	Chemistry Branch, Library, Personnel Branch, Photographic Section of Publications Branch, Personnel Branch, Radiological Safety Branch, Barracks, Health Services Division, Chemical Technology and Nucleonics Divisions, Security Division, Health Physics Division, Employee Relations Branch, Photographic and Illustrating Sections, and Pathology Laboratory	Demolished
509 Site	E	Library. There is no existing reference to this building as a use area nor is it mentioned in the building-by-building Pu-239 and Ra-226 release survey from 1955 when NRDL consolidated; however, contamination has been found in the area. This building was adjacent to building 517.	Demolished
510 Site	E	Weapons Test Sample Storage, Non-NRDL Training Facility, NRDL Radiation Facility, Glassblowing, Woodworking and Machine Shops, Physics Branch, Nuclear Radiation Branch, and Research Engineering Section Physics Branch	Demolished
510A Site	E	NRDL Kevatron Facility, NRDL X-Ray Facility, SUPSHIPS Record Storage, and Fire Research Facility	Demolished
517 Site	E	Former Brig and NRDL Cobalt Animal Irradiation Facility	Demolished
520 Site	E	Shipyard Dental Clinic and NRDL Administrative Offices	Demolished
521	E	Power Plant and South Area. This is one of two suspected sites of fuel oil burning from three OPERATION CROSSROADS target ships.	Unoccupied
529 Site	E	NRDL Isotope Storage Facility (Vault) and Neutron Generator. When the building was renovated for installation of the accelerator the vault was filled with compacted sand and capped with eight inches of concrete.	Demolished
701 Site	E	Storage Building that NRDL requested for “temporary” (120 days) storage of samples in 1947. Building still in process of transfer to HPS in 1950. Still listed as used by NRDL in 1954.	Demolished
704 Radioactive Material Area	E	Radioactive material storage area	Wagner Construction
704 Animal Pens	E	Animal pens for NRDL	Wagner Construction
707 and Kennels	E	Research Animal Facility (used by NRDL for animal breeding and housing), Waste Processing and Storage Facility, and Formerly Leased to Pet Express as an Animal Clinic	Unoccupied
707B Site	E	NRDL Animal colony	Demolished

TABLE 8-1
IMPACTED SITES AT HPS
CURRENT USES

Building/ Site No.	Parcel	Former Use	Current Status
707C Site	E	Nuclear Weapons Test Support and Experimentation, Equipment Issue and Receiving Area	Demolished
707 Triangle Area	E	NRDL Radioactive Waste Receiving, Packaging and Storage Area, Suspected Septic Tank and Leach Field from Early Operations. Possible large animal facility.	Open Area
708	E	Research Animal Facility, Bio-medical Facility. Animal Psychology Facility	Unoccupied
719 Site	E	Incinerator. Potentially used by NRDL animal facility at Building 707.	Demolished
807 Site	E	Scrap Yard Processing Shed. Possibly received scrap materials from ship decontamination.	Demolished
810	E	LLRW and IDW Storage Location (PRC), Storehouse, Paint Activities, Paint and Oil Storage	Unoccupied
Shack 79 Site	E	NRDL support: “radioactive material”	Demolished
Shack 80 Site	E	NRDL support; shack reported to have been moved from behind Building 506 to Building 704 area for “lab operations”	Demolished
Experimental Shielding Range	E	Experimental shielding range. Ship shielding studies	Unused open land
IR-01/21, Industrial Landfill Area	E	Landfill used from 1940s to 1974 for disposal of industrial and solid wastes; domestic wastes and refuse; building construction and demolition wastes; dredge spoil materials; sandblast waste; shop industrial, chemical, and solvent wastes; ship solid and liquid wastes from repair activities; and radioluminescent devices, primarily Ra-226. Potentially used for disposal of wastes from decontamination of OPERATION CROSSROADS ships.	Open area
IR-02, Bay Fill Area	E	Bay Fill Area used for disposal of assorted shipyard wastes, which included Ra-226 and Sr-90 devices. Areas known as IR-02 Northwest and Central contain an apparent concentration of the devices. Potentially used for disposal of wastes from decontamination of OPERATION CROSSROADS ships.	Open area
IR-03, Oil Reclamation Ponds Area	E	Oil Reclamation Ponds, HPS Fuel Oil Reclaiming Plant. Possible area for disposal of assorted shipyard wastes, which may have included Ra-226 and Sr-90 devices, and oil.	Open area

TABLE 8-1
IMPACTED SITES AT HPS
CURRENT USES

Building/ Site No.	Parcel	Former Use	Current Status
IR-04, Scrap Yard	E	Post-Disassembly Area (Scrap Yard) for metals, equipment, and other unusable items from the Salvage Yard that could have contained Ra-226 devices and other contaminants.	Open area, partially used by train museum
Salvage Yard	E	Pre-Disposal Disassembly Area for metals, equipment, and other reusable items that could have contained Ra-226 devices and other contaminants.	Unoccupied
Shore Line	E	Approximately 1.5 miles of shoreline along the Bay starting at the southeast corner (near Berth 36) to the HPS property line in the southwest corner of IR-01/21 used for debris disposal. Includes areas known as "metal reef" and "metal slag area."	Open land area bordering the Bay
Storm Drain Lines (also listed as IR-50)	Base-Wide	Combined Storm and Sanitary Sewer Drains. Due to the nature of the separation process, radiological contamination from the same source could have impacted the piping and other components of both systems.	In use
Sanitary Sewer Lines (also listed as IR-50)	Base-Wide	Sewer System. Due to the evolutionary nature of the separation process, radiological contamination from the same source could have impacted the piping and other components of both systems.	In use
Septic Systems and Associated Drain Fields	Base-Wide	Septic Systems	Abandoned in place
Underwater Areas	F	Discharge of residue from OPERATION CROSSROADS decontamination operations, underwater experimentation, radioactive waste disposal accidents, contaminated water discharges, and storm and sewer discharge	Open water
Ships Berths	F	Berthing of OPERATION CROSSROADS ships, Berthing of the YGN-73 (radioactive waste disposal barge), and NRDL usage (berthing of experimental barges and YAGs-39 and 40)	Unused
ICW 418	Off Site	Used by NRDL as Storehouse, QARA Welding Engineering Facility (at Islais Creek), Hydro Chemical Services, and TMCM	Vacant
815	FUDS	Main NRDL Research Facility	Sold to Mr. Ted Lowpensky, and occupied by Filesafe, Inc.
820	FUDS	Machine Shop for Cyclotron Construction and NRDL Cyclotron Laboratory	Sold to Mr. Ted Lowpensky, and used as Lowpensky Moulding, a wood moulding shop
830	FUDS	NRDL Research Animal Breeding Facilities and Kennels	Sold to University of California at San Francisco
831	FUDS	Research Animal Facility	Sold to University of California at San Francisco

TABLE 8-2
BUILDING/AREA ASSESSMENT AND CLASSIFICATION

Building No. or Area	Contamination Potential					Contaminated Media							Potential Migration Pathways							Recommended Actions
	Known Restricted Access	Known-Continued Access	Likely	Unlikely	Unknown	Surface Soil	Subsurface Soils	Surface Water	Ground Water	Air	Structures	Drainage System	Surface Soil	Subsurface Soil	Surface Water	Ground Water	Air	Structures	Drainage System	
Parcel A																				
813				✓		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Scoping Survey
816				✓		N	N	N	N	N	N	N	N	N	N	N	N	N	N	Released by CDHS – No Further Action
819			✓			N	N	N	N	N	L	M	N	N	N	N	N	L	M	Scoping Survey
821				✓		N	N	N	N	N	N	N	N	N	N	N	N	N	N	Released by CDHS – No Further Action
Parcel B																				
103				✓		N	N	N	N	N	L	L	N	N	N	N	N	L	N	Review Final Status Survey Report
113				✓		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Review Final Status Survey Report
113A				✓		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Review Final Status Survey Report
114				✓		L	N	N	N	N	N	N	L	N	N	N	N	N	N	Scoping Survey
130				✓		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Review Final Status Survey Report
140 and Discharge Channel				✓		N	N	N	N	N	L	L	N	N	N	N	N	L	L	Scoping Survey
142				✓		L	N	N	N	N	L	N	L	N	N	N	N	L	N	Scoping Survey
146			✓			N	N	N	N	N	L	N	N	N	N	N	N	L	N	Characterization Survey
157				✓		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Scoping Survey
IR-07				✓		L	L	N	N	N	N	N	L	L	N	N	N	N	N	Scoping Survey
IR-18				✓		L	L	N	N	N	N	N	L	L	N	N	N	N	N	Scoping Survey
Drydock 5				✓		N	N	N	N	N	L	L	N	N	N	N	N	L	L	Scoping Survey
Drydock 6				✓		N	N	N	N	N	L	L	N	N	N	N	N	L	L	Review Final Status Survey Report
Drydock 7				✓		N	N	N	N	N	L	L	N	N	N	N	N	L	L	Scoping Survey

TABLE 8-2
BUILDING/AREA ASSESSMENT AND CLASSIFICATION

Building No. or Area	Contamination Potential					Contaminated Media							Potential Migration Pathways							Recommended Actions
	Known Restricted Access	Known-Continued Access	Likely	Unlikely	Unknown	Surface Soil	Subsurface Soils	Surface Water	Ground Water	Air	Structures	Drainage System	Surface Soil	Subsurface Soil	Surface Water	Ground Water	Air	Structures	Drainage System	
Parcel C																				
203				✓		L	N	N	N	N	L	N	L	N	N	N	N	L	N	Scoping Survey
205 and Discharge Channel				✓		N	N	N	N	N	L	L	N	N	N	N	N	L	L	Scoping Survey
211		✓				N	N	N	N	N	M	L	N	N	N	N	N	L	L	Remediation and Final Status Survey
214				✓		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Review Final Status Survey Report
224			✓			N	N	N	N	N	L	N	N	N	N	N	N	L	N	Review Final Status Survey Report
241				✓		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Review Final Status Survey Report
253		✓				N	N	N	N	N	H	H	N	N	N	N	N	M	M	Complete Characterization Survey/Remediation
271				✓		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Review Final Status Survey Report
272				✓		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Review Final Status Survey Report
Drydock 2			✓			N	N	N	N	N	M	L	N	N	N	N	N	L	L	Review Final Status Survey Report
Drydock 3			✓			N	N	N	N	N	M	L	N	N	N	N	N	L	L	Review Final Status Survey Report
Drydock 4			✓			N	N	N	N	N	M	L	N	N	N	N	N	L	L	Review Final Status Survey Report
Parcel D																				
274				✓		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Review Final Status Survey Report
313 Site			✓			L	L	N	N	N	N	N	L	L	N	N	N	N	N	Review Final Status Survey Report
313A Site			✓			M	L	N	N	N	N	M	L	L	N	N	N	N	L	Review Final Status Survey Report
317 Site			✓			L	L	N	N	N	N	N	L	L	N	N	N	N	N	Review Final Status Survey Report
322 Site			✓			L	N	N	N	N	N	N	L	N	N	N	N	N	N	Review Final Status Survey Report
351			✓			N	N	N	N	N	M	L	N	N	N	N	N	L	L	Review Final Status Survey Report
351A		✓				M	N	N	N	N	M	M	M	N	N	N	N	L	L	Characterization Survey
364		✓				H	M	N	N	N	H	H	M	L	N	N	N	M	M	Remediation and Final Status Survey

TABLE 8-2
BUILDING/AREA ASSESSMENT AND CLASSIFICATION

Building No. or Area	Contamination Potential					Contaminated Media							Potential Migration Pathways							Recommended Actions
	Known Restricted Access	Known-Continued Access	Likely	Unlikely	Unknown	Surface Soil	Subsurface Soils	Surface Water	Ground Water	Air	Structures	Drainage System	Surface Soil	Subsurface Soil	Surface Water	Ground Water	Air	Structures	Drainage System	
Parcel D (Continued)																				
365				✓		N	N	N	N	N	L	L	N	N	N	N	N	L	L	Review Final Status Survey Report
366/351B		✓				N	N	N	N	N	M	M	N	N	N	N	N	L	L	Remediation and Final Status Survey
383				✓		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Review Final Status Survey Report
408			✓			N	N	N	N	N	M	N	N	N	N	N	N	L	N	Scoping Survey
411				✓		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Review Final Status Survey Report
Gun Mole Pier			✓			L	L	N	N	N	L	N	L	L	N	N	N	L	N	Review Characterization Report
500				✓		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Scoping Survey
503 Site			✓			N	L	N	N	N	N	L	N	L	N	N	N	N	L	Scoping Survey
Mahan Street-NRDL			✓			M	M	N	N	N	N	N	L	L	N	N	N	N	N	Review Final Status Survey Report
Parcel E																				
406			✓			N	N	N	N	N	M	N	N	N	N	N	N	L	N	Review Final Status Survey Report
414				✓		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Review Final Status Survey Report
500 Building Series			✓			M	H	N	N	N	N	H	L	M	N	N	N	N	H	Scoping Survey
506 Site			✓			M	M	N	N	N	N	M	L	L	N	N	N	N	M	Scoping Survey
507 Site			✓			L	L	N	N	N	N	M	L	L	N	N	N	N	L	Characterization Survey
508 Site			✓			L	L	N	N	N	N	M	L	L	N	N	N	N	L	Characterization Survey
509 Site			✓			L	L	N	N	N	N	M	L	L	N	N	N	N	L	Characterization Survey
510 Site			✓			L	L	N	N	N	N	M	L	L	N	N	N	N	L	Characterization Survey
510A Site			✓			L	L	N	N	N	N	M	L	L	N	N	N	N	L	Scoping Survey
517 Site			✓			L	L	N	N	N	N	M	L	L	N	N	N	N	L	Characterization Survey
520 Site		✓				M	M	N	N	N	N	M	M	M	N	N	N	N	L	Characterization Survey

TABLE 8-2
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Building No. or Area	Contamination Potential					Contaminated Media							Potential Migration Pathways							Recommended Actions
	Known Restricted Access	Known-Continued Access	Likely	Unlikely	Unknown	Surface Soil	Subsurface Soils	Surface Water	Ground Water	Air	Structures	Drainage System	Surface Soil	Subsurface Soil	Surface Water	Ground Water	Air	Structures	Drainage System	
Parcel E (Continued)																				
521				✓		**L**	**N**	**N**	**N**	**N**	**L**	**N**	**N**	**N**	**N**	**N**	**N**	**N**	**N**	Scoping Survey
529 Site		✓				**M**	**M**	**N**	**N**	**N**	**M**	**H**	**L**	**L**	**N**	**N**	**N**	**L**	**M**	Scoping Survey
701 Site				✓		**L**	**N**	**N**	**N**	**N**	**N**	**N**	**L**	**N**	**N**	**N**	**N**	**N**	**N**	Review Final Status Survey Report
704 Area			✓			**L**	**L**	**N**	**N**	**N**	**N**	**N**	**L**	**L**	**N**	**N**	**N**	**N**	**N**	Scoping Survey
704/Pens				✓		**L**	**L**	**N**	**N**	**N**	**N**	**N**	**L**	**L**	**N**	**N**	**N**	**N**	**N**	Scoping Survey
707/Kennels		✓				**L**	**L**	**N**	**N**	**N**	**L**	**M**	**L**	**L**	**N**	**N**	**N**	**L**	**M**	Characterization Survey
707 B Site				✓		**L**	**L**	**N**	**N**	**N**	**N**	**N**	**N**	**L**	**N**	**N**	**N**	**N**	**L**	Characterization Survey (as part of 707 Triangle Area Survey)
707 C Site				✓		**L**	**L**	**N**	**N**	**N**	**N**	**N**	**L**	**L**	**N**	**N**	**N**	**N**	**N**	Characterization Survey as (part of 707 Triangle Area Survey)
707 Triangle Area		✓				**L**	**H**	**N**	**N**	**N**	**N**	**H**	**L**	**M**	**N**	**N**	**N**	**N**	**M**	Characterization Survey
708				✓		**L**	**N**	**N**	**N**	**N**	**L**	**N**	**L**	**N**	**N**	**N**	**N**	**N**	**N**	Review Final Status Survey Report
719 Site				✓		**L**	**L**	**N**	**N**	**N**	**N**	**N**	**L**	**N**	**N**	**N**	**N**	**N**	**N**	Scoping Survey
807 Site				✓		**L**	**L**	**N**	**N**	**N**	**N**	**N**	**L**	**L**	**N**	**N**	**N**	**L**	**N**	Scoping Survey
810		✓				**M**	**N**	**N**	**N**	**N**	**M**	**N**	**L**	**N**	**N**	**N**	**N**	**L**	**N**	Remediation and Scoping Survey
Shack 79 Site			✓			**M**	**L**	**N**	**N**	**N**	**N**	**N**	**L**	**L**	**N**	**N**	**N**	**N**	**N**	Final Status Survey
Shack 80 Site		✓				**H**	**M**	**N**	**N**	**N**	**N**	**N**	**M**	**L**	**N**	**N**	**N**	**N**	**N**	Remediation and Final Status Survey
Experimental Shielding Range			✓			**M**	**L**	**N**	**N**	**N**	**N**	**N**	**L**	**L**	**N**	**N**	**N**	**N**	**N**	Review Final Status Survey Report
IR-01/21, Industrial Landfill		✓				**H**	**H**	**N**	**N**	**N**	**N**	**N**	**M**	**M**	**N**	**N**	**N**	**N**	**N**	Review Characterization Survey Report, Remediation, and Final Status Survey

TABLE 8-2
BUILDING/AREA ASSESSMENT AND CLASSIFICATION

Building No. or Area	Contamination Potential					Contaminated Media							Potential Migration Pathways							Recommended Actions
	Known Restricted Access	Known-Continued Access	Likely	Unlikely	Unknown	Surface Soil	Subsurface Soils	Surface Water	Ground Water	Air	Structures	Drainage System	Surface Soil	Subsurface Soil	Surface Water	Ground Water	Air	Structures	Drainage System	
Parcel E (Continued)																				
IR-02, Bay Fill		✓				**H**	**H**	**N**	**L**	**N**	**N**	**N**	**M**	**M**	**N**	**L**	**N**	**N**	**N**	Characterization Survey
IR-03			✓			**M**	**M**	**N**	**N**	**N**	**N**	**N**	**L**	**L**	**N**	**N**	**N**	**N**	**N**	Scoping Survey
IR-04		✓				**H**	**M**	**N**	**N**	**N**	**N**	**N**	**M**	**L**	**N**	**N**	**N**	**N**	**N**	Characterization Survey
Former Salvage Yard			✓			**M**	**M**	**N**	**N**	**N**	**N**	**N**	**L**	**L**	**N**	**N**	**N**	**N**	**N**	Scoping Survey
Shoreline		✓				**H**	**M**	**L**	**N**	**N**	**N**	**N**	**M**	**M**	**L**	**N**	**N**	**N**	**N**	Characterization Survey
Base-Wide																				
Storm Drain lines		✓				**N**	**L**	**N**	**N**	**N**	**L**	**H**	**N**	**L**	**N**	**N**	**N**	**L**	**M**	Scoping/Characterization Surveys of systems associated with NRDL sites or sites associated with radium use
Sanitary Sewers		✓				**N**	**L**	**N**	**N**	**N**	**L**	**H**	**N**	**L**	**N**	**N**	**N**	**L**	**M**	Scoping/Characterization Survey of systems associated with NRDL sites or sites associated with radium use
Septic Systems			✓			**N**	**M**	**N**	**N**	**N**	**N**	**H**	**N**	**L**	**N**	**N**	**N**	**N**	**M**	Scoping/Characterization Surveys of systems associated with NRDL buildings
Parcel F																				
Underwater Areas			✓			**N**	**L**	**N**	**N**	**N**	**N**	**N**	**L**	**N**	**N**	**N**	**N**	**N**	**N**	Scoping Surveys in areas of CROSSROADS decontamination activities and site outfall discharge
All Ships' Berths				✓		**L**	**L**	**N**	**N**	**N**	**L**	**N**	**L**	**L**	**N**	**N**	**N**	**L**	**N**	Review Final Status Survey Report for completed berths; Scoping Survey on remainder
Off-Site Facility																				
ICW 418				✓		**N**	**N**	**N**	**N**	**N**	**L**	**N**	**N**	**N**	**N**	**N**	**N**	**L**	**N**	Scoping Survey

TABLE 8-2
BUILDING/AREA ASSESSMENT AND CLASSIFICATION

	Contamination Potential					Contaminated Media							Potential Migration Pathways							
Building No. or Area	**Known Restricted Access**	**Known-Continued Access**	**Likely**	**Unlikely**	**Unknown**	**Surface Soil**	**Subsurface Soils**	**Surface Water**	**Ground Water**	**Air**	**Structures**	**Drainage System**	**Surface Soil**	**Subsurface Soil**	**Surface Water**	**Ground Water**	**Air**	**Structures**	**Drainage System**	**Recommended Actions**
FUDS																				
815			✓			**L**	**N**	**N**	**N**	**N**	**M**	**L**	**L**	**N**	**N**	**N**	**N**	**L**	**L**	Scoping Survey
820				✓		**N**	**N**	**N**	**N**	**N**	**L**	**N**	**N**	**N**	**N**	**N**	**N**	**L**	**N**	Scoping Survey
830				✓		**N**	**N**	**N**	**N**	**N**	**L**	**N**	**N**	**N**	**N**	**N**	**N**	**L**	**N**	Scoping Survey
831				✓		**N**	**N**	**N**	**N**	**N**	**L**	**N**	**N**	**N**	**N**	**N**	**N**	**L**	**N**	Scoping Survey

Notes:

H High = Evidence of contamination in the media or migration pathway has been identified.
L Low = The potential for contamination in the type of media or migration pathway is remote.
M Moderate = The potential for contamination in the media or migration pathway exists, although the extent has not been fully assessed.
N None = Evidence of contamination in the specific media or migration pathway has not been found, or known contamination has been removed, and surveys indicate that the media or migration pathway meet today's release criteria.

9.0 CONCLUSIONS

9.1 HISTORICAL RESEARCH

HPS was purchased in 1939 by the Navy, who assumed operational control of the yard in December 1941, at the beginning of America's involvement in WW II. Throughout its operational history, G-RAM was introduced to HPS in various forms and for various operations. Because of the location of the NRDL at HPS, the potential for residual contamination is greater than at other Navy shipyards.

9.2 IMPACTED SITE ASSESSMENTS

The preparation of the HRA was an extended process that involved review of thousands of records from 14 federal and private records repositories, electronic mail, and telephonic contact with 200 persons with potential knowledge of radiological operations at HPS. The information extracted from this process identified a total of 882 HPS historic and current sites, including buildings, structures, defined open areas, drydocks, and ships' berths. Of these, a total of 90 HPS sites have been designated as "impacted." This indicates that the site has a potential for radioactive contamination based on historic information or is known to contain radioactive contamination. These impacted sites, broken out by parcel, include:

Parcel A – 4 sites
Parcel B – 14 sites
Parcel C – 12 sites
Parcel D – 17 sites
Parcel E – 33 sites
Parcel F – 2 sites
Off-Base Facilities – 1 site
Base-Wide Areas – 3 sites
FUDS – 4 sites

The potential for residual contamination at impacted sites was assessed using the following categories: Known-Restricted Access, Known-Continued Access, Likely, Unlikely, and Unknown. The assessment of potential contamination at the 90 impacted sites is summarized as follows:

0 – Known-Restricted Access
17 – Known-Continued Access
32 – Likely
41 – Unlikely
0 – Unknown

The categories high, moderate, low, and none were used to assess potentially contaminated media for each impacted site. The highest level of potentially contaminated media at each of the 90 impacted sites is presented below.

High – 12 sites
Moderate – 26 sites
Low – 50 sites
None – 2 sites; these sites were free-released previously by RASO and CDHS

The categories of high, moderate, low, and none were also used to assess potential migration pathways for any radioactive contamination at each impacted site. The highest level of migration pathways assessed at each of the 90 impacted sites is presented below.

High – 1 site
Moderate – 17 sites
Low – 70 sites
None – 2 sites; previously free-released by RASO and CDHS

The categories of Emergency Action, Scoping Survey, Characterization Survey, Remediation, Final Status Survey, Free Release, and No Further Action were used to recommend future actions at each of the impacted sites. The recommended actions for each of the 90 impacted sites are presented below.

Emergency Action – 0 sites
Scoping Survey – 34 sites
Characterization Survey – 20 sites
Remediation – 5 sites
Final Status Survey – 1 site
Free Release pending Review of Final Status Survey Report – 28 sites
No Further Action – 2 sites

9.3 OVERALL CONCLUSIONS

Using the above criteria, the HRA concludes that:

- The potential for residual radioactive contamination exists and needs to be addressed at 62 of the impacted sites.
- The potential for residual radioactive contamination has been addressed at 26 impacted sites. Contamination at these sites was either not present or found and remediated. These sites are recommended for free release pending review of the Final Status Survey Report by the Navy and appropriate regulatory agencies.
- Two of the impacted sites require No Further Action because they were assessed previously and determined to be qualified for free release by RASO and CDHS.
- To date, no historical information about radiological operations or previous radiological investigations at any of the impacted sites presents a level of concern that would require any Emergency Action.
- To date, high-level contamination has not been found at the site nor is the potential considered a possibility by the HRA.
- To date, no impacted site requires restricted access or special protective equipment for workers due to known levels of undisturbed radioactive contamination.
- To date, no evidence for potential airborne contamination has been found.
- To date, potential pathways for contamination migration remain within the impacted site areas. No pathway has been identified for contamination to migrate off the HPS site.

The overall conclusion of the HRA is that, even though there is potential residual radioactive contamination at 60 of the 90 impacted sites, the contamination is expected to be at low levels within the confines of HPS. Recommendations have been made to assess the remaining areas of potential contamination and address its removal. To date, no evidence has been identified that would indicate that shipyard tenants, the surrounding community, and the environment are at risk from previous radiological activities at HPS.

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APPENDIX A
RADIATION OVERVIEW

APPENDIX A RADIATION OVERVIEW

A1 GENERAL

Radiation is energy in the form of electromagnetic waves or subatomic particles. Radiation is emitted from the nucleus or electron cloud of atoms or from devices generating electromagnetic waves and particles such as x-ray machines, neutron generators, and cyclotrons. Radiation is either *ionizing* or *non-ionizing*.

Radiation that has insufficient energy to remove electrons from atoms is non-ionizing radiation. Examples of non-ionizing radiation include most visible light, infrared light, microwaves, and radio waves. Radiation that has sufficient energy to remove electrons from atoms is ionizing radiation. All radiological investigations at HPS have focused on ionizing radiation, which includes alpha, beta, and gamma radiation.

A2 ALPHA RADIATION

Alpha particles are charged particles containing two protons and two neutrons. Alpha particles are emitted from the nuclei of certain heavy atoms, such as uranium, when they decay. Because of its size and heavy electrical charge, +2, an alpha particle can travel only a few centimeters in air. It can be stopped or shielded by a sheet of paper. Alpha particles cannot penetrate the outer layer of skin but can cause localized damage inside the body if ingested or inhaled.

A3 BETA RADIATION

Beta particles are particles with the mass of an electron and a -1 electrical charge; essentially, they are high-velocity electrons. Radioactive isotopes of many different elements emit beta particles. Even though moderate energy beta particles can travel as far as 10 feet through air, they easily can be stopped by a 1/3-inch-thick sheet of plastic or a 1/8-inch-thick sheet of aluminum. Because beta particles can penetrate the outer layer of skin and affect living tissue, they are a hazard to the body's skin and the eyes.

A4 GAMMA RADIATION

Gamma radiation is electromagnetic radiation with no mass or charge. Gamma rays are emitted from the nucleus of an atom during radioactive decay. Because it has no mass or charge, gamma radiation can penetrate most materials. In air, higher energy gamma radiation can travel several hundred feet. Gamma radiation can penetrate the skin and interact with the dense structures of the body. Dense materials such as lead or concrete are needed for shielding against gamma radiation.

A5 X-RAYS

X-rays are also electromagnetic radiation with no mass or charge. The difference between gamma radiation and x-radiation is the nature of their origin. Gamma radiation originates in the nucleus, while x-rays originate in the electron region of the atom. The penetrating properties are the same; therefore, safety concerns and shielding mechanisms are similar. X-rays are typically produced by machines, and thus are not a hazard if the machine is turned off.

A6 SCIENTIFIC NOTATION

Radiation measurement units are normally reported in scientific notation. Scientific notation is also known as exponential notation or power-of-10 notation. It is a concise method of expressing numbers from very small to very large. Scientific notation is the expression of a number raised to a power of 10. For example, 3,456 can be expressed as 3.456×10^3. For the purpose of this HRA, scientific notation is often used when radiation units are reported.

Here is a listing of common numbers expressed in scientific notation:

10^6 = 1,000,000	10^{-1} = 0.1 (1/10)
10^5 = 100,000	10^{-2} = 0.01 (1/100)
10^4 = 10,000	10^{-3} = 0.001 (1/1000
10^3 = 1000	10^{-4} = 0.0001 (1/10,000)
10^2 = 100	10^{-5} = 0.00001 (1/100,000)
10^1 = 10	10^{-6} = 0.000001 (1/1,000,000)
10^0 = 1	

A7 RADIATION UNITS

For this HRA, radiation measurements are stated in units of curies, roentgens, rads, rems, and reps. These units are defined as:

- **Curie (Ci).** The curie measures radioactivity; 1 curie is that quantity of a radioactive material that will have 37,000,000,000 (3.7×10^{10}) transformations in 1 second. Often radioactivity is expressed in smaller units like thousandths (10^{-3}, millicurie or mCi), millionths (10^{-6}, microcurie or μCi), billionths (10^{-9}, nanocurie or nCi), or trillionths (10^{-12}, picocurie or pCi) of a curie.
- **Roentgen (R)**. The roentgen is a unit used to measure exposure. It describes an amount of gamma and x-rays present in air only. The roentgen is a measure of the ionization of the molecules in a mass of air: one roentgen is equal to depositing in dry air enough energy to cause an electrical charge of 2.58×10^4 coulombs per kilogram (kg) (1 kg = 2.2 pounds). The main advantage of this unit is that it is easy to measure directly, but it is limited because it is only for deposition in air and only for gamma and x-rays.
- **Rad (from radiation absorbed dose).** The rad is a unit used to measure absorbed dose. This relates to the amount of energy actually absorbed in some material. It is used for any type of radiation and any material. One rad is defined as the absorption of 100 ergs per gram of material. The unit rad can be used for any type of radiation, but it does not describe the biological effects of different radiations.
- **Rem (from roentgen equivalent man).** The rem is a unit used to derive a quantity called equivalent dose. This relates the absorbed dose in biological tissue to the biological effect. Not all radiation has the same biological effect, even for the same amount of absorbed dose. Equivalent dose is often expressed in terms of thousandths of a rem, or millirem (mrem). To determine equivalent dose in rem, absorbed dose (rad) is multiplied by a quality factor (Q) that is unique to the type of incident radiation and the material in which the energy is deposited.
- **Rep (from roentgen equivalent physical).** A unit of absorbed radiation dose equal to the amount of ionizing radiation that will transfer 93 ergs of energy to 1 gram of water or living tissue.

APPENDIX B
INTERVIEWS

APPENDIX B: INTERVIEWS

B1. GENERAL

Archival research conducted during preparation of the Hunters Point Shipyard (HPS) Historical Radiological Assessment (HRA) was augmented by contacts with people who had knowledge of radiological operations at HPS. These people either worked at HPS or the Naval Radiological Defense Laboratory (NRDL) or at related activities (such as OPERATION CROSSROADS weapons tests), were family members of deceased ex-employees, or had historical information unavailable in the archives. These contacts resulted in interviews with ex-HPS, Radiation Laboratory (RADLAB), and NRDL employees and family members that were deemed to be of particular importance to the HRA.

To make contact with these people, the Navy posted a newspaper advertisement looking for personnel with knowledge of radiological operations at HPS. Because the shipyard was so prominent in the San Francisco Bay (Bay) area, the Navy advertised in newspapers where the highest concentration of former employees would be expected. The following advertisement was published in the *San Francisco Chronicle*, *San Francisco Examiner*, *San Francisco Independent*, the *Bay View*, and the *Sacramento Bee*:

HUNTERS POINT SHIPYARD
NEEDS YOUR HELP

The Navy is presently seeking to interview current and former Navy personnel, civilian employees and contractors regarding radiological operations at Hunters Point Shipyard. Southwest Division, Naval Facilities Engineering Command is working with the Navy's Radiological Affairs Support Office in the preparation of the Final Draft Historical Radiological Assessment (HRA) for Hunters Point Shipyard. The HRA will document the radiological history of the shipyard, including former uses of radioactive materials and sites where radioactive materials were used or disposed. Radiological operations at Hunters Point may have been conducted by any of the following employers or their contractors: Hunters Point Naval Shipyard, San Francisco Bay Naval Shipyard, Mare Island Naval Shipyard, Naval Radiological Defense Laboratory (NRDL), or Triple A Machine Shop.

Face-to-face interviews as well as telephonic or e-mail interviews can be arranged. Information resulting from interviews will be used for preparation of the HRA, environmental investigations and restorations, and public safety purposes. The Navy is interested in obtaining open and honest oral histories. The Navy is not interested in pursuing adverse action against interviewees based on information supplied during the interviews that may describe improper handling, use or disposal of radioactive material or disclose sensitive material. **If you are a current or former member of the Navy, civilian employee or contractor and have information about radiological operations at Hunters Point Shipyard, please contact Daryl DeLong, New World Technologies, DarylD@newworld.org, 1-800-443-7164.**

Two hundred-six people responded to the advertisement. Respondents were initially screened to determine if they could provide information relevant to the HRA. Based on the screening criteria, 162 qualified for follow-up interviews. Most of the other 44 respondents were seeking employment at HPS and knew nothing of former radiological operations. Of the 162 that qualified for follow-up interviews, 148 were contacted by telephone or electronic mail (e-mail). Attempts to contact the remaining 14 were not successful. Communications with the 148 respondents resulted in referrals to many additional people. Other referrals were provided by the HPS Restoration Advisory Board (RAB) members. As a result, 31 additional names were provided, resulting in a total of 171 contacts. Of the 171 people who were contacted, 29 were selected for either face-to-face or telephonic in-depth interviews.

Before specific questions were asked, each interviewee was informed about the purpose of the interview and was given a brief background about the HRA. Topics discussed during the interview included the former employee’s position, responsibilities, period(s) of employment, and how they were involved with, or knowledgeable of, radiological operations at HPS or NRDL.

HPS-related information for interviewees and their current cities of residence are summarized in Table B-1. In some instances, interviewees would not release residential information. These are included in the table without the city of residence.

B2. SUMMARY OF THE INTERVIEW PROCESS

The main purpose of the interviews was to obtain first-hand information about the conduct of radiological operations at HPS. This information was used to attempt to fill in gaps in the historical record and to find additional documents concerning radiological activities at HPS.

Daryl DeLong and Bert Williams of NWT, the company hired by the Navy to assist in preparation of this HRA, performed the initial screening of personnel responding to the advertisement. This screening determined if the respondents could provide information relevant to the HRA. In addition to common personal information, the questions included the time period the respondent was associated with HPS, the work they did there, and if or how they knew of any work with radioactive material. The criteria for inclusion in follow-up interviewing were liberal, and most respondents received a follow-up call or e-mail. Laura and Richard Lowman of Naval Sea Systems Command, Radiological Affairs Support Office (RASO), and John Polyak of NWT did follow-up interviews.

During the follow-up interview, specific questions were asked about employment history and details of the respondent's knowledge of radiological issues at HPS. They were also asked if they had any relevant documents in their possession. Based on their responses, especially their knowledge of radiological operations at HPS or if they possessed documents, candidates were chosen for in-depth face-to-face or telephone interviews. Face-to-face interviews were conducted at locations convenient for the interviewees, typically in their homes. Transcripts of these interviews are included in the Individual Interviews section below.

Among the people interviewed were 24 who worked at NRDL before 1955 (15 percent of the total number of interviewees). This was important because it was the year the laboratory moved most of its activities into Building 815 from other facilities scattered through the shipyard. Eight worked at NRDL and its predecessors before 1951, the year the last CROSSROADS ship (the carrier INDEPENDENCE) left HPS to be sunk at sea. Most had little or no recollection of the CROSSROADS ships. One sandblaster who worked on at least two of the Amphibious Tank Landing Ships (LST) involved in CROSSROADS tests remembered working on the ships, including details about the disposal of the sandblast waste, both at sea and in the base landfill.

Interviewees typically remembered their work in detail, but professed to have little knowledge about work done by others not in their work group. For example, only NRDL Health Physics Division personnel knew details of the disposition of radioactive materials (waste disposal). However, the interviewees' perception that work at the NRDL was done to high standards was nearly universal. Almost to a person, those who had worked at NRDL were insistent that the laboratory was operated carefully and that waste was disposed of properly, within the framework of the regulations and limits of the time they worked there.

In general, the interviews confirmed what was available in the researched historical records but did not reveal any new information. The interviewees offered no documents having a direct impact on the HRA; very few of them took documents with them when they left HPS and NRDL. A few kept extensive records important to them, but these records were not relevant to analyzing radiological conditions at the site today.

B3. INTERVIEWEE DEMOGRAPHICS

The search for interviewees yielded a broad spectrum of respondents from the United States and one from Canada. Most of the respondents were from California, with approximately 67 percent, many of them retired, living in the Bay area. While this possibly reflects a bias from the advertisement appearing in California newspapers, it also indicates a high concentration of ex-employees and retirees residing there.

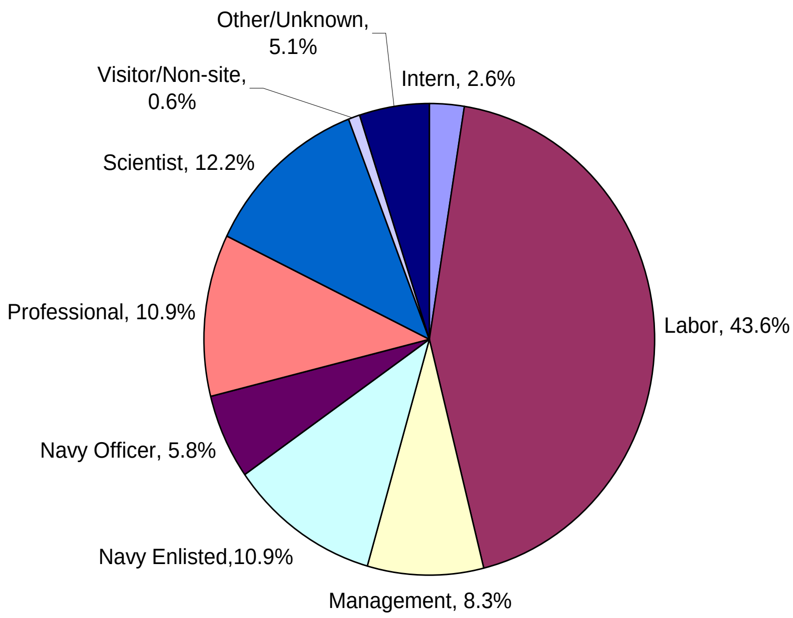
The remaining third of respondents represented the remainder of California and the country. Ex-HPS personnel who did not live in the Bay area learned about the search from friends and relatives who saw the ad and mentioned it to them. Others were referred to the project by interviewees who responded to the ad and suggested ex-co-workers who might have relevant information. Some of the interviewees had moved to another part of the country to work after NRDL or the shipyard closed. Former employees of HPS often remained where they had moved after they retired from their post-HPS and NRDL work locations.

Because most radiological work at HPS and NRDL was done 30 or more years ago, many of the people who responded to the advertisement are now retired. Many had vivid memories of day-to day operations at the shipyard and NRDL. Several participated in atomic and thermonuclear weapons testing at the Pacific and Nevada test sites. Most were proud of their accomplishments at HPS and NRDL and remembered their employment at HPS and NRDL as an enjoyable and productive period in their lives.

In order to better understand the statistical distribution of interviewees, their work experiences have been divided into the following nine categories:

- **Interns:** summer employees who worked primarily at NRDL; for example, tending the animal colonies
- **Labor:** non-military employees who performed the broad spectrum of tasks and craft work needed to keep the yard operating; riggers, mechanics, sandblasters, painters, and other crafts
- **Management:** those who managed and directed work but who were not in the military
- **Military Enlisted:** enlisted military personnel, primarily Navy, who were assigned to non-management tasks; for example, Navy hospital corpsmen worked as animal keepers at NRDL
- **Military Officer:** military, primarily Navy, officers who were assigned to HPS and NRDL as managers, overseers, and scientists
- **Professional:** civilian employees doing non-labor work, such as engineering, bookkeeping and planning, but were not management
- **Scientist:** primarily RADLAB and NRDL employees who performed scientific experiments
- **Visitor/Non-site:** did not work at HPS, but visited the site; there was only one and he visited HPS on Navy Day as a child
- **Other/Unknown:** those for whom no category above was applicable

Figure B.1. Interviews by Category



With interns, enlisted military, and labor included, 60.5 percent of interviewees represent the shipyard workforce. The remaining 39.5 percent were non-labor, professional employees of the HPS and NRDL.

B4. INDIVIDUAL INTERVIEWS

The following are transcripts of individual in-depth interviews. These transcripts include 13 personnel that were interviewed previously during preparation of the Draft HPS HRA that was released in March 2002.

Attempts were made to contact all 29 personnel selected for in-depth interviews but some personnel could not be reached. Personnel who were contacted were interviewed by Laura Lowman or Richard Lowman of RASO or John Polyak of NWT. After being interviewed, the original transcripts for each interview were mailed to the interviewee with a cover letter explaining the purpose of the mailing, stating that the approved transcript would be published in this HRA, and asking the recipient to make any necessary corrections or additions to the transcript. The interviewee was asked to sign the document as a release for the information to be included in the HRA. Some personnel chose not to return the transcript or authorize release.

The information below comes from interview transcripts and is included with the interviewees' consent. Personal information is not provided out of respect for the interviewees' privacy. No personal information will be provided to another agency or private party without written permission of the interviewee.

DR. EDWARD ALPEN

Dr. Alpen was the Associate Director of Life Sciences (Medicine) at NRDL. He worked there from 1950 until the laboratory closed in 1969.

Dr. Alpen was responsible for all animal experiments at NRDL. His section occupied the entire fifth floor and half the first floor of Building 815. Facilities for larger animals were located in Buildings 707 and 830 at HPS and at Camp Parks. Dr. Alpen was not involved with the daily operations of these facilities, but he is certain they were operated and maintained to the highest standards.

Dr. Alpen insisted that NRDL employed quality personnel who operated the laboratory to the highest professional standards. He remembers the period before NRDL's closure as one of knowing closure was inevitable, but he believes the laboratory was a valuable asset that should have been preserved.

URBAN CUMMINGS

Mr. Cummings began employment at HPS as a 16-year-old apprentice electrician in 1942. He remained at HPS until 1944 when he joined the Army. He returned to HPS after being released from the Army following World War II (WW II) and stayed at HPS until 1953.

After returning from the war, one of Mr. Cummings' jobs was to calibrate Geiger-Mueller radiation detectors. The calibrations were conducted on the third floor of Building 253 using a cobalt-60 (Co-60) source that was contained in a large lead "pig" or shield. There were no formalized procedures; however, the process was to open the heavy door of the pig to expose the Co-60 source and then hold the instrument at areas on the floor that were marked with what the instrument should read. If it did not read correctly, Mr. Cummings would take a screwdriver and adjust the instrument until the reading matched the markings on the floor.

Mr. Cummings stated that he did not know of the location(s) of a radioluminescent paint shop. However, if there had been one it would probably have been in Building 253.

Mr. Cummings remembers that Building 253 was originally called the Radio Shop and later became known as the Electronics Shop.

Mr. Cummings stated that there were numerous slaughterhouses on Evans Avenue as soon as you turned off Third Street and that the stench from these caused everyone to breathe through their mouths.

Mr. Cummings had no knowledge of a tunnel in the hill on shipyard property

RICHARD DAVIS

Mr. Davis worked at NRDL from 17 July 1965 to 3 November 1969. Originally hired as a temporary summer worker, Mr. Davis was appointed to a permanent position as animal keeper when an accident crushed the knee of the keeper he replaced (an animal cage fell on him on the back of a truck). Mr. Davis stated it was a case of "who you knew" to get hired at NRDL.

Mr. Davis worked on the fifth floor of Building 815 and at Building 707. His duties included the cleaning and feeding of mice, rats, rabbits, dogs, hogs, sheep, burros, and goats. New dogs were quarantined in Building 707 before they were used by NRDL. Larger animals were kept in pens at 707. The larger animals were pretty quiet, while the dogs were noisy. NRDL also kept rats in a 500-series building, but Mr. Davis did not recall the specific building number.

A mouse-breeding colony originally housed on the fifth floor of Building 815 was moved to a new building across the street from 815. The mouse-breeding colony was used to prepare pathogen-free animals for experiments. The gray-white mice were bred to get specialized LAF-1 brownish mice. Everything was autoclaved before coming into contact with theses animals.

Mr. Davis stated he did not work directly with radioactive materials, only irradiated animals and those that had been dosed with radioisotopes. He said there were no criteria for collection of animal excreta and that urine was flushed down the drain and solids were collected on screens and discarded in the trash. The cage pans were washed into the screened floor drains. They did not allow animals that had been dosed with radioactive materials out of their cages.

Dead, non-radioactive large animals at Buildings 707 and 815 were put in 30-gallon garbage cans and then into drums for the rendering company. Large animals were cut apart to fit into the 30-gallon drums. Dead, non-radioactive small animals, i.e. mice and rats, were put in the regular trash. Mr. Davis did not dispose of animals that had been dosed with radioisotopes. Once a month or so, personnel would kill excess animals to prevent animal overpopulation at NRDL. Mr. Davis believes these animals were buried in the HPS landfill.

An x-ray machine, used to irradiate animals, was located on the fifth floor of Building 815 in a room adjacent to a storage area used by the animal keepers who would often eat lunch there while animals were being irradiated next door.

Mr. Davis wore a film badge but does not remember any anomalous readings.

Mr. Davis remembers rumors of NRDL's closing a few months before the closure announcement, but he does not remember when word got out that the lab was going to close. Logistics people evaluated the lab materials and much of value was discarded into dumpsters for disposal. He remembers reagent-grade silver and palladium being thrown away.

TIM DOXEY

Mr. Doxey worked at Mare Island Naval Shipyard (MINS) from the mid-1970s through closure in 1996.

He remembers MINS using only one building at HPS and it was used for briefings, but he could not remember the building number. MINS used Drydock 4 because it was large enough to accommodate a carrier. Any radioactive materials used for MINS work were stored outside on the northwest side of the drydock or in a hull.

Radiological work in Drydock 4 included decontamination of ships' hulls or emergent hull work when USS ENTERPRISE damaged her hull on an undersea mountain.

Any radiological waste was either trucked back to MINS or shipped to Naval Air Station (NAS) Alameda. Trucking back to MINS required going around the Bay as the bridges were not approved routes.

Mr. Doxey did not recall doing any surveys of buildings, as they were not required at the time. However, he did remember release surveys (versus closure surveys) being done on Drydock 4 and about 50 feet around it.

FILBERT FONG

Mr. Fong was employed by NRDL from 1957 to 1969. Following his work there, he worked for the Naval Ordnance Laboratory from 1969 to 1970; MINS from 1970 to 1971; the California Department of Health Services (CDHS), Radiological Health Branch, from 1971 to 1976; the U.S. Nuclear Regulatory Commission (NRC), Region V, from 1976 to 1980; the Department of Energy, San Francisco Operations Office, from 1980 to 1992; and the CDHS, Radiological Health Branch, from 1992 to 1997. Mr. Fong is a Registered Professional Engineer in Safety with the State of California. Mr. Fong is currently retired.

Mr. Fong worked in the Health Physics Division of NRDL. The Health Physics Division was responsible for overseeing safe use of radioactive materials and machines that produced ionizing radiation.

Mr. Fong stated that there were dosimeters placed in areas of interest around Building 815. This included the fence that separated the Navy housing from the shipyard property above 815. He also stated that there were no dosimeters placed on the roof, but that there may have been photodosimeters that were usually exchanged on a monthly basis. Environmental photodosimeters were changed by the Navy corpsmen assigned to the Dosimetry Section.

Additionally, Mr. Fong stated there were monitors that continuously sampled the air on the roof of Building 815. The air filters were changed daily except weekends and holidays. He remembered changing and counting the filters many times. NRDL used the air monitors to account for any airborne radioactivity releases to the Atomic Energy Commission (AEC).

Mr. Fong stated that there was a strict separation of radioactively contaminated and clean items. NRDL had specially designed containers (5-gallon carboys) for liquid radioactive waste in every laboratory. No radioactive liquids were allowed to be discarded into any laboratory sink. The liquid in the containers was collected for storage in the low-level liquid radioactive waste tank at Building 364. The procedure was that the 5-gallon carboy radioactive liquid containers would be sampled to determine the radioisotopes and concentrations. If the liquid met concentration limits, the liquid was poured into the sink at Building 364 that drained to the underground storage tank. This tank was emptied, after sampling for contents and concentration, by a private AEC-licensed disposal company for disposal in Nevada.

Mr. Fong recalled that during one of the AEC inspections, NRDL was asked how they demonstrated that all releases were less than 1 curie per year (the Title 10, *Code of Federal Regulations*, Part 20 requirement at the time) or that no radioactive releases were made into the public sewer system. There were no data to show that NRDL had complied with this requirement. So, NRDL built a non-contaminated water holdup tank system for all liquid releases from Building 815 that was separated from the sanitary sewage line. The waste water in these tanks was monitored to demonstrate that NRDL met the liquid release limits established by the AEC before allowing it to enter the public sewer system. To the best of Mr. Fong’s recollection, at no time were the contents of the tank held up because of elevated radioactivity concentrations.

Mr. Fong stated that the Health Physics Division was not involved with the disposal of non-radioactively contaminated animals. He remembers NRDL disposing of normal waste (trash, papers, animal parts, non-radioactively contaminated animals) through the shipyard waste disposal system. NRDL had no concern where the shipyard disposed of these wastes since they were not radioactively contaminated. If the shipyard used the landfill for disposal of shipyard waste and NRDL’s normal waste was intermingled with the waste from the shipyard, then it is possible that NRDL’s non-contaminated trash went into the shipyard landfills. However, when NRDL started to dispose of their normal waste with a commercial company, NRDL contracted with a separate company to dispose of biological waste and animal parts.

Mr. Fong stated that Building 821, located across the street from Building 815 and adjacent to Building 820, housed the 1-MeV x-ray facility. Radioisotopes were not used in Building 821and therefore there could not be any contamination of that building. Mr. Fong stated that if animal irradiations were conducted at that facility, there would not be any residual contamination produced as the result of the x-radiation. He remembers the facility was barely completed and tested when NRDL was disestablished.

Mr. Fong stated that Building 816 housed the 2-MeV Van de Graaff accelerator and was on the same side of the street as Building 815. The walls of the target room had tritium (H-3) contamination due to the outgassing of the H-3 targets. He remembers animals being irradiated with the accelerator a few times, but stated the animals were not injected with radioactive material nor were the animals activated to the point of becoming radioactive. He remembers the building being decontaminated and documented for NRC final clearance.

While he was not there at the time, Mr. Fong stated he had the impression that the contaminated sandblast media from decontaminating the OPERATION CROSSROADS ships and any other radioactive materials were placed in 55-gallon drums and sunk with the ex-INDEPENDENCE. He also stated that not everything on the INDEPENDENCE was contaminated or radioactive.

Mr. Fong stated that, while he cannot speak to the shipyard, there was no nuclear reactor ever located at NRDL. He also stated that the Cyclotron never went fully operational or produced radioisotopes. Mr. Fong said that, in general, NRDL did not produce radioactive material. Radioactive materials transferred to NRDL were radioactive when the material was received. He said NRDL used radioactive materials but did not make them more radioactive (e.g., by fission reactions).

Mr. Fong remembers Buildings 830 and 831 being built to breed and house small animals, including a pathogen-free colony. Usually healthy animals were brought from the complex to researchers on the fifth floor of Building 815 for experimentation. Whether these animals were injected with radionuclides or not, they were housed at the animal facility on the fifth floor and not returned to Buildings 830 or 831. Mr. Fong remembers Buildings 830 and 831 being declared “no radioactive material” areas.

Mr. Fong stated that Building 529 was property of the shipyard that was loaned to NRDL, who modified the interior of the building for their own purposes. He stated that when the Kevatron was bought in the 1960s, it was originally housed on the fourth floor of Building 815. It was later moved to Building 529, where it remained until the closure of NRDL. He believes that NRDL returned a radiologically cleaned Building 529 to the shipyard and that the building was eventually dismantled by the shipyard.

To the best of Mr. Fong’s recollection, NRDL did not demolish any shipyard buildings that they used. He doubted that NRDL would spend its funds to demolish property owned by the shipyard and would just return the building to HPS. He stated that NRDL did not transport any contaminated structures out of the shipyard as trash. Before buildings were turned back to the shipyard, NRDL’s Health Physics Division would survey, and decontaminate if necessary, all parts of the building. Each building received a final documented clearance before it was used for non-radiological work. If the shipyard chose to demolish a building formerly used by NRDL, they demolished a clean building.

Mr. Fong recalled experimentation done on the ex-INDEPENDENCE to test the levels of exposure sailors would receive from detonation of an atomic weapon. To do this, a Co-60 source was placed in a plastic pipe that ran the length of the INDEPENDENCE. The source was moved through the pipe by water so they could get uniform exposure rates and check the attenuation effect of the decks and compartments. Dosimeters were hung throughout the ship to measure the exposure that the sailors would have received.

Mr. Fong was questioned about a false floor that was found in Building 364. Mr. Fong had no recollection of this, but felt it was possible that researchers may have needed to elevate the original floor so that their remote handling manipulators could reach the floor of the hot cell. Mr. Fong did remember that a contaminated aircraft engine from an atomic test was decontaminated in Building 364.

While Mr. Fong worked at NRDL in the Health Physics Division from 1957 to 1969, Mr. Fong was not at NRDL during the termination phase in 1969 and 1970. However, while working for the CDHS as a regulator from 1992 to 1997, Mr. Fong oversaw closure of HPS. This included the free release of Building 816 and deliberations on what to do with the Ra-226 dials in the landfill.

WILLIAM GRAVATT

Mr. Gravatt began employment at HPS as an electrician's helper in 1948. He remained at HPS until 1972, working as a painter apprentice, a painter, a planner in the Paint Department, and finally as an industrial engineer.

Mr. Gravatt remembered the sandblasting of the OPERATION CROSSROADS ships. He stated that it would have been impossible to catch and containerize all sandblast grit in the drydocks as there was always a constant flow of some water around the keel blocks and that some of the sandblast grit would have gone into the water at the end of the drydocks. He also remembers some of the sandblast grit being in open barrels on the piers. Some this blew around because of the nature of the winds at the piers. He believed that some of the sandblast grit might have been taken to the landfill and dumped.

Mr. Gravatt remembered the USS GEORGE EASTMAN (YAG-39) and USS GRANVILLE S. HALL (YAG-40) being sandblasted topside at the pier by the large crane. He stated that this sandblast grit would have blown around the pier because of the wind at that location.

Mr. Gravatt did not specifically remember a radioluminescent material paint shop; however, he was sure that if it existed it was not in the Paint Shop buildings. He stated there might have been a small radioluminescent paint booth in the Electronics Shop in Building 253, most likely located on the third floor.

Mr. Gravatt was not familiar at all with NRDL operations.

Mr. Gravatt had no knowledge of Buildings D-19, D-20, or D-21 or any other storage buildings off the shipyard property.

Mr. Gravatt stated that the first floor of Building 253 contained gun pits where naval gun mounts could be brought from the ships to be repaired and checked out. He stated that the mezzanine of Building 253 was dedicated to office spaces.

Mr. Gravatt had no knowledge of a tunnel in the hill on shipyard property and said if there had been one he surely would have known as an industrial engineer.

HARRY GRIFFITH

Mr. Griffith was a Navy Corpsman assigned to NRDL from mid-1967 until October 1969. He worked primarily at the Navy Clinic at HPS. However, on duty days he was often assigned to feed the animals in the animal colony at Building 707.

Mr. Griffith did not know if any of the animals at Building 707 had been injected with radioisotopes and returned to the building. He stated that the animals at Building 707 were dogs, rats, and mice. The larger animals, such as hogs and sheep, were kept at Camp Parks.

Mr. Griffith stated that in the evenings the HPS Medical Clinic provided medical care for civilians from the Bayview/Hunters Point area.

CYNTHIA (NEIL) GRUSZKIEWICZ

Mrs. Gruszkiewiecz was a Bacteriologist in the Bio-Medical Division at NRDL from 1961 through 1964. She is a graduate of San Francisco State University. She trained as a Medical Technologist a at two Alameda County hospitals and worked as a Medical Technologist at Saint Francis Hospital, San Francisco before joining NRDL. A Medical Technologist in California must be a college graduate in biology, chemistry, or microbiology and have passed a California Technologist license examination. Mrs. Gruszkiewiecz was hired by NRDL to find the source of an epidemic that was causing lung lesions in the disease-free rat colony at the lab. Her predecessor had worked on this problem for 3 years without finding the source of the infection. Mrs. Gruszkiewiecz was the only bacteriologist for the about 30,000 animals at the lab.

All her animal work was done on the fifth floor of Building 815. There were also moths at the lab for experimental work. They were kept in the Radiation Laboratory next to her lab. She was told that they became very active when they were exposed to radiation. The bulk of her work was done with mice and rats. She did animal blood work and found the source of infection. She also did blood work on burros and horses at Camp Parks. There was a disease-free Sprague-Dahley rat colony on the fifth floor that was kept isolated from the remainder of the lab animals. Excess mice and rats were given to the San Francisco Aquarium to feed the reptiles.

Each investigator at NRDL was studying some aspect of radiation effects on the animals they worked with. There were very few women working at NRDL. She only remembered four to eight of them working on the fifth floor. She was the only female investigator in one area of the fifth floor.

When questioned about the possibility that contaminated animal wastes were discarded into the building drain system. She said that the animal cages had paper in the waste trays under them and that urine was absorbed in the paper and the solids were collected with the paper and discarded into the radioactive waste containers in the lab. These papers were probably the source of contaminated transfer to the disease-free colony.

Ms Gruszkiewiecz did post-mortems on irradiated animals, but did not work with those that had been dosed with radioactive material. She wore a film badge because there was an X-ray machine in the room next to her lab. She doesn't recall getting any measurable dose.

Although she found the lab a fascinating place to work, she left there because, in her opinion, there were three types of scientists there she found unacceptable:

- The "head in the clouds" types who were oblivious to everything going on around them
- The "hacks" who did routine work, minded their own business, and were unoriginal
- The "political" types, whom she considered not true scientists, whose only goal was to advance to the top no matter what it took

She also considered some of her colleagues to be "scientifically dishonest."

Mrs. Gruszkiewiecz recounted the story of the scientist who was responsible for the colony of pathogen-free animals she was hired to investigate. She wanted to euthanize and post-mortem some of them to see if they were healthy. He resisted her efforts until he was finally told to let her do the work. She did find lesions in the supposed germ-free colony and the animals had to be destroyed. The scientist wouldn't talk to her after this event.

JOHN HENWOOD

Mr. Henwood began employment at HPS as a sheet metal worker in 1952. He remained there until 1973, working as a foreman of the sheet metal shop and then as an operational safety supervisor responsible for inspecting safety conditions in each shipyard shop and building on a quarterly basis.

In the 1960s, Mr. Henwood was responsible for removing broken Sr-90 deck markers from aircraft carriers and installing new ones. He recalls that the broken ones were always missing the plastic capsule that contained the radioactive material. During the deck marker removal, they wore special protective clothing and worked a special 7-hour shift with no lunch break. No eating was allowed until after the shift and shipyard radiation control personnel monitored them before they left the ship. Contamination was never found on Mr. Henwood, but procedures were in place for treatment of contaminated personnel that included showering, followed by additional monitoring.

Once the deck markers were removed, Mr. Henwood placed them in a box and took them to a Butler building at the head of the gun mole pier where he turned them over to shipyard radiological controls personnel. Mr. Henwood has no knowledge of how the deck markers were disposed of after that.

Mr. Henwood remembered working on one aircraft carrier that had come in for emergency repairs and still had at least one nuclear weapon still aboard.

Mr. Henwood worked on a converted Navy merchant ship, which was one of the YAGs that were outfitted for testing. He manufactured and installed small animal cages in the cargo hold of the ship. It is believed to have been the USS GEORGE EASTMAN (YAG-39) because he described a major wash down system on the ship with nozzles everywhere topside and a system like that was only installed on YAG-39. The animal cages were small and suited for guinea pigs or rats, although he stated he never physically saw any animals in the cages.

Mr. Henwood stated that anyone working topside on the YAG had to wear a protective suit and be monitored for radioactive contamination prior to leaving the ship. A 7-hour workday with no lunch hour was also in effect when he worked onboard YAG-39. There were three Butler buildings at the head of the Gun Mole Pier. Shipyard radiation control personnel used one of these buildings for work on the YAGs. They used the same building where he turned in the broken deck markers. He additionally stated that the YAGs did not remain in the shipyard for an extended period of time.

Mr. Henwood believes that there may have been radioactive material in the electronic shop. He described this shop as a tall building with a small footprint. The upper floor required a secret clearance for admittance. It was near Drydock 4 and across the street from the Shipfitter Shop. After looking at a map, he believed that it might have been Building 331. He said it was not Building 253.

Mr. Henwood did not recall a radioluminescent material paint shop at the shipyard.

Mr. Henwood has no knowledge of NRDL operations.

Mr. Henwood stated that the Marine sentries at the HPS South gate would shine spotlights up the hill to avoid being shot at by people on the top of the hill and that the random shootings were a common problem for personnel entering through the south gate.

Mr. Henwood stated that at some point, shipyard management was given the option of purchasing the large crane or constructing a larger dry dock and they opted for what was then the world's largest crane.

Mr. Henwood remembered the sandblast grit being scooped out of the dry docks and dumped in the landfill. He stated that a lot of waste material was dumped in the landfill.

Mr. Henwood had no knowledge of a tunnel in the hill on shipyard property; however, he remembered a tunnel outside the base on the street that approached the main gate that was used by a water company.

ROY J. HOLLOWAY

Mr. Holloway began his career at NRDL on 2 July 1951. He initially worked on the second floor of Building 506, studying liver physiology. This is a field he studied for 12 to 14 years at NRDL, even after moving to Building 815. He remembered a hot cell in one of the buildings near the theatre, but he could not remember the building number. He personally did not use any radioactive materials in the building or hot cell.

Mr. Holloway was heavily involved with animal experiments and described experiments where animal livers would be extracted and kept alive in the experimental rig while studies of their physiology were performed. He remembered a germ-free rat colony in the animal facility across the street from Building 815. There were also animals kept on the fifth floor of 815. Mr. Holloway referred to this building as the 815 Annex, which he said was the part of 815 to the southeast of the main entrance. There was also a machine shop on the first floor of 815 and a Cs-137 source in a calibrator on the third floor. He used this calibrator to calibrate the dosimetry he used with his animals. He did not know what was done with animal remains, but he did state that the Health Physics personnel under Al Baietti were extremely competent and conscientious. They were responsible for radioactive waste disposal. He did remember waste being disposed of at sea.

He was at Camp Parks once and remembers it being a large facility. He never attended any weapons tests. He did remember using radioactive isotopes as tracers for the liver studies, but he could not remember the specific isotopes he used.

At the time of the laboratory's shutdown in 1969, Mr. Holloway was running the tissue culture section and also studying the effects of ionizing radiation on small animals. His study on small rodents centered on damage and repair in various physiological systems. They had a microtome at the lab, and he was using it to prepare his cultures. He said that it was obvious the lab was going to close because BUMED dropped their support of the lab's research programs. He stated emphatically that there were never any human liver experiments at NRDL, nor could he recall any other human experimentation.

ESPANOLA JACKSON

Ms. Jackson has lived in the Hunters Point/Bayview section of San Francisco since 1948 and was married to someone in the Navy who previously was stationed at HPS. She is a community activist who is very much interested in the activities at HPS.

Ms. Jackson did not have information about radiological operations at HPS.

Ms. Jackson stated that Italian and Samoan immigrants lived in Hunters Point before the predominance of African-Americans since WW II.

Ms. Jackson has along history of community activism. She is a member of the HPS RAB and was the motivating force to get the RAB instituted after attending a RAB in Monterey, California. She is working with the Indian tribe that originally populated the Hunters Point/Bayview area and is trying to have the Hunters Point property returned to the tribe, which has approximately 500 members and is headquartered in San Diego. Ms. Jackson showed Mr. Polyak her tribal membership card. Ms Jackson stated she is passionate about her desire to have the shipyard cleaned and released to the Indians.

MICHAEL KAY

Mr. Kay worked at NRDL as a student trainee part-time and during the summers from 1960 to 1963. He worked full time as a radiochemist from January 1963 to January 1964. After a budget cut, he came back part-time in 1965 before going to graduate school. He worked on the sixth floor of Building 815.

Mr. Kay worked primarily with fresh samples brought back from the nuclear weapons tests at the Nevada Test Site. These samples contained almost all fission products having half-lives from a few weeks to many years. He noted that the isotopes remaining today would be mainly Cs-137 and Sr-90.

He recalled that often the chemistry laboratory material (liquid waste) was sent to Building 364 to be prepared for disposal and stated he would expect to see Cs-137 and Sr-90 contamination at Building 364.

Mr. Kay also stated that work involving the development of strontium-titanate was conducted in the laboratory next to his office on the sixth floor of Building 815. This material was instrumental in the development of the first Navy radioisotope thermoelectric generators (RTG) for powering remote underwater devices.

Mr. Kay also recalled U-235 samples being irradiated in the Lawrence Livermore TRIGA reactor then transported back to NRDL, where they were chemically separated in laboratories on the sixth floor of Building 815. Mr. Kay worked with the group doing this work that led to the discovery and determination of the half-life of cadmium-121 as a fission product. Radioactive waste was produced with all the other fission products except the cadmium-indium-tin series.

The Chemistry Division on the sixth floor of Building 815 also did extensive tracer chemistry on fused salts using long-lived tracers such as Cs-137.

Mr. Kay questioned whether anyone had done a survey for toxics at HPS. He was informed that they were being done and that in 1989 HPS was put on the National Priorities List (NPL) for toxics.

DR. WILLIAM KREGER

Dr. Kreger worked at NRDL from 1952 until 1969. He originally worked for Dr. C. Sharp Cook in the Nucleonics Division and took over as Division Head when Dr. Cook left NRDL for a year. Dr. Kreger stated that this division had four branches: Nuclear Radiation Protection, Accelerators, Radiation Detection Instruments, and Shielding. He originally worked in Building 510 and moved to the fourth floor of Building 815 when it opened in 1955.

Dr. Kreger recalled working in a small building close to Building 351A and Dr. Cook was in Building 351A. The Nucleonics Division worked with sealed sources and some plated alpha sources similar to sources that are standard in calibration laboratories today. The division used a variety of sources and isotopes for their experiments. Dr. Kreger remembered using Co-60, Cs-137, and Na-24. They used small sources to calibrate their NaI detectors and large sources, particularly Co-60, to perform experiments. They did penetration tests onboard ships using a large Co-60 source.

The Nucleonics Division was responsible for measuring shielding effects of various building materials. They measured radiation penetration into structures and the attenuation of radiation by different building materials. They used radiation detectors and dosimetry to measure radiation penetration; however, they were not responsible for measuring personnel doses.

Dr. Kreger remembered that there were no source storage facilities for their sources designed into Building 815. Sources were stored in caves they constructed on the fourth floor. They worked closely with Mr. Al Baietti’s Health Physics Group. The Health Physicists did routine radiation monitoring and checked sources for leakage. Dr. Kreger is certain the Health Physicists were careful in handling radioactive materials and they enforced regulatory requirements in place at the time. He considered the Radiation Safety Section (RSS) staff extremely professional, and they constantly worked to ensure that the scientific staff followed all radiation safety rules.

Dr. Kreger was considered a shielding expert and led many of the shielding studies conducted at NRDL and HPS.

The Nucleonics Division was responsible for the Van de Graaff and Cyclotron accelerators. They used the Van de Graaff in their penetration experiments. The Cyclotron had just begun operating at low power levels when NRDL was closed in 1969.

Dr. Kreger was one of four NRDL people told the laboratory was going to close a year before the actual closure. He believed the unique collection of talent that had been gathered to staff the laboratory and thought its dispersal after closure would be a grave error. Dr. Kreger was one of several prominent scientists at NRDL that went to Washington in 1969 to lobby Congress not to cut the NRDL program and lose a valuable asset. He actively lobbied both legislators and the Navy to keep NRDL operating in some fashion. Legislators favored keeping it open, but the Navy did not.

After the laboratory closed, Dr. Kreger worked for Physics International in San Leandro, California, for 3 years. He is now retired.

JERRY KUNZMAN

Mr. Kunzman worked as an Electronics Engineer at NRDL in Building 815 from 1959 until 1967.

Mr. Kunzman was responsible for evaluation of the AN/PDR-27 and AN/PDR-56 radiation survey instruments as well as foreign-developed instruments. He used sealed gamma sources and plated alpha sources similar to those used in a calibration laboratory today.

Mr. Kunzman was also involved in electronic circuit board hardening testing. This testing was done to develop materials for Navy shipboard electronic equipment to minimize loss of this equipment during a nuclear attack. Mr. Kunzman confirmed that these tests were conducted in a TRIGA reactor at General Dynamics in San Diego.

Mr. Kunzman received a citation for his work in providing instrumentation that was vital in the location of the USS THRESHER after it sank in the Atlantic Ocean.

Mr. Kunzman also knew the RSS staff and Radioisotope Committee members very well and stated that they ran a very effective radiation safety program and closely controlled the uses of radioactive material and radiation producing machines at NRDL.

JOHN R. LAI

Mr. Lai began employment at HPS as an analytical chemist in 1947. In 1948, he accepted employment as a radiological chemist with the department that later became the NRDL. Upon closure of NRDL in 1969, he accepted employment as a chemist at the Naval Air Rework Facility in Alameda, California.

Mr. Lai started his work as a radiological chemist in Buildings 506 and 510. One of these buildings had been the HPS Medical Clinic before it was converted for NRDL's use. After construction of Building 815, his office was moved to the sixth floor of that building.

Mr. Lai analyzed samples returned from the atomic tests for plutonium and fission products and he worked on decontamination experiments.

Mr. Lai was present in the South Pacific for the first hydrogen bomb test. This was the Mike device test that he stated resulted in a much larger yield than anticipated. His task was to bring fallout samples back and analyze them. The fallout sampled was from downwind and the task was to determine fallout patterns and the ratio of fission products. The sample plates for this task were 2 feet by 1 foot. He brought the sample plates back from the test on an aircraft that landed at NAS Alameda, California. The plates were transferred from there to the NRDL for testing.

Mr. Lai's job, working in the analytical sections of the lab in the early days of NRDL, was to aliquot and distributes portions of the various radioisotopes ordered from Oak Ridge National Laboratory (ORNL) to the various scientists for their research; short-lived iodine-131 was one of these isotopes.

Mr. Lai recalled a rumor that a person died of radiation exposure; however, Mr. Lai later determined it was a medical overdose of radiation prior to the gentleman's work at NRDL. He believed that the person's name was Sherwin and he may have been in the field group tasked with recovering samples from atomic and nuclear tests.

Mr. Lai stated that he had no knowledge of disposal of any animals used by NRDL for testing.

During his time as an analytical chemist with HPS, Mr. Lai's primary duties were to analyze diesel submarine batteries and to analyze samples for trace materials. He had no knowledge of radiological materials during this time.

EDWARD LEAHY

Mr. Leahy worked as a Health Physicist at NRDL. He worked there from 1955 until January 1962. He worked for Mr. Al Baietti in the Health Physics Group. From 1962 until the laboratory closed in 1969, Mr. Leahy held various positions in the Military Evaluation Division. At closure, he was requested to rejoin the Health Physics Group and assisted in NRDL's closure

While in the Health Physics Group, Mr. Leahy's primary responsibility was coverage of the scientists in the Physics Group. They did not generate a lot of radioactive waste, so his work mainly consisted of doing surveys as the physicists experimented. He recalled that when he found radioactive contamination, he did his own decontamination.

Mr. Leahy was not aware of the use of radium or having a radium paint shop in Building 815. He did not process radioactive waste nor did he work with animals.

Mr. Leahy was not surprised by NRDL's closure. He felt that it had been apparent the shipyard was to close and NRDL's closure was coming. Mr. Leahy was a surveyor for the closure team. They performed a thorough survey of Building 815, including all the building drains. He remembered finding black iron pipe that had been painted to look like the stainless steel pipe that was supposed to be there. This subterfuge was between the floor and the ceiling below where no one would be likely to find it. Building 815 surveys were done with AN/PDR-27 geiger counters and Eberline PAC-3G alpha detector instruments. If any contamination was found, it was cleaned up. He isn't aware of radioactivity outside Building 815, and he believes the building was "clean" (not detectable by the monitoring instruments available in 1969) when they left.

WILLIAM LOCKRIDGE

Mr. Lockridge worked at MINS in Code 300 from July 1981 to closure.

Mr. Lockridge does not recall MINS doing any land-based nuclear work when they used HPS facilities. All nuclear work was done in the hull or the radioactive material was taken to MINS for work.

He recalled working at HPS in 1985 to do hull repair and minimal propulsion plant work on ENTERPRISE. He also did Selected Restricted Availability (SRA) work on CALIFORNIA. Mr. Lockridge estimated his time spent at HPS as 45 days.

Ships were not berthed at HPS; they would remain at NAS Alameda until the drydock was ready and then they came to HPS. Temporary trailers were used instead of HPS buildings.

MINS used a number of buildings at HPS. These included Building 301 (Plan of the Day meetings), Building 300 (bathroom), Building 367 (storage), and Building 439 (ECC, C300, NRRO, and warehouse for non-nuclear material.) The Security Trailer was at the head of the drydock. While being used by MINS, Drydock 4 was enclosed by a guarded Controlled Industrial Area (CIA) just like at MINS. The CIA followed the road going around the drydock. Various temporary trailers were also used, some of which were placed on the decks of the ships.

Release surveys included Drydock 4 and "transport paths." However, Mr. Lockridge did not remember if office spaces were surveyed

DR. ROBERT MATHER

Before he was hired at NRDL in the fall of 1951 as a civilian working for the Navy, Dr. Mather worked at the Naval Ordnance Laboratory in Washington, DC, and earned a masters degree in physics at Columbia University in 1947. He then went to the University of California at Berkeley, where he earned a PhD in Physics with a thesis topic on Cerenkov radiation. He began his work at NRDL in a small wooden building and then moved into the fourth floor of Building 815. Dr. Mather worked at NRDL until it closed in 1969. Dr. Mather then went to work at Naval Ocean Systems in San Diego until he retired in 1984.

Dr. Mather's specialty at NRDL was the study and detection of fallout. Dr. Mather attended six weapons tests in Nevada where he collected fallout samples for evaluation back at NRDL. He remembers always being extremely careful with the fallout samples, as some of them were particularly radioactive. He stated there were thousands of isotopes in the fallout; however, his laboratory did not work with plutonium. Dr. Mather remembers one December when fallout alarms at NRDL alarmed due to fallout from a Chinese atmospheric test.

In 1956, Dr. Mather created a truck-mounted fallout collector for use at the Nevada test site that was featured in the August 1956 issue of *Nucleonics* magazine. The truck was equipped with a continuous radiation monitor and appropriate alarms.

Dr. Mather stated that the work at NRDL was done professionally and that the Health Physics group did radiation monitoring and control to a high standard.

ROBERT O'BRIEN

Mr. O'Brien started working at MINS in 1962 and worked through the base closure in 1996. He began working in the Testing and Refueling Divisions before moving to the Radiation Control (RADCON) Directorate in 1979.

The first NNPP work at HPS was done in the mid-1980s on the USS ENTERPRISE. The last NNPP work there was in the 1990s. Nuclear submarine work was done at MINS; HPS only did diesel boat work. Mr. O'Brien only recalls Drydock 4 being used for NNPP work at HPS. He doesn't recall any HPS buildings being used, either, as they were "generally in shambles." However, there was a CIA established around Drydock 4 that included a few buildings.

Waste was collected in drums inside the fenced area at Drydock 4. Steam generator cleaning was all secondary side work, so there was no radioactive contamination. All liquid and solid wastes were taken to MINS. He knows of no liquid radioactive waste discharge from or processed at HPS. Air was only monitored if they were doing radiological work.

Mr. O'Brien recalled working on the USS CALIFORNIA, TEXAS, and ENTERPRISE.

There was no use of high-efficiency particulate air (HEPA) filtration at HPS. MINS brought a portable building with a deep-well counter, but it was not HEPA-filtered. The building was removed after the final release survey.

Work done at HPS included steam generator cleaning, structural work, alterations to radioactive systems, and hull decontamination. Hull decontamination was done with drapes, vacuum cleaners, and scrapers on the USS CALIFORNIA in Drydock 4. Mr. O'Brien recalls Drydock 4 being used four times.

There was no storm drain sampling since they only used the drydock.

Drydock 4 was surveyed before and after each use, and nothing was found as a result of MINS work in the drydock. However, one release survey found a radium button in a drainage trough.

JOSEPH D. O'CONNOR

Mr. O'Connor was a Chemist at NRDL from 1951 to 1969. He began his career at NRDL working in Building 406 (possibly 506, he's not clear on the actual building number.) He does remember the building being of single-story frame construction and fenced off with the cafeteria to its right. The theater was also nearby. He was in this building from 1951 until the labs were completed in Building 351. They moved into 351 at this time, but he wasn't certain of the date. In 1955, he moved to Building 815. He worked in the radiochemistry lab on the sixth floor of 815, right below the cafeteria.

Mr. O'Connor prepared and counted samples of fallout and debris from weapons tests. He did isotope separations and tracked sample decay. He remembered that, at first, the Navy used military personnel and laboratory engineering support help (carpenters and machinists) to collect samples. Later, chemists and physicists supervised the collection of fallout materials and verification of sample locations. Every effort was made to assure that the sample collected represented the fallout that landed at that particular sample station.

Sample materials were typically dissolved in fuming nitric acid, separated for rare earths, for example, and specific elements were precipitated for counting procedures and isotope identification. Some samples were very small (e.g., single particles); others were representative samples collected in aluminum pans 2 feet square by 2 inches deep. Sample collection became more sophisticated over the years, and instrumental analysis replaced some of the wet chemistry procedures. Most soil sample preparation was done in lab hoods to contain aerosols while some liquid samples could be handled outside the hood.

The Health Physics (HP) group monitored sample handling for disposal. Solutions were neutralized and placed into five-gallon plastic carboys with screw tops and collected by the HP group for disposal. Solid waste was packed in 55-gallon steel drums and hauled away by truck.

Samples that were counted daily and radioactive counting standards were kept in small lead caves in various lab spaces. Mr. O'Connor remembered that there was a lean-to or shed behind the frame lab building (406 or 506) where sources may have been stored. The lab made some of its own sources and purchased others. Cs-137 was used as a counting standard. The lab seldom dealt with radium unless it was for a specific, tightly controlled experiment.

Mr. O'Connor was adamant about the lab and spills. He was upset about the librarian who was quoted in the *San Francisco Chronicle* who claimed she/he had knowledge of spills at the lab. He said if they spilled anything, HP promptly cleaned it up. He also stated they would not have talked about spills, particularly to the librarian. He remembered there were people working there who took risks, mainly with their own exposure at weapons test sites. There were no overexposures at the lab of which he was aware.

Mr. O'Connor was on the YAG-40, GRANVILLE HALL, in 1956 for tests at Bikini. He witnessed six tests there. Samples were prepared and counted on the YAG and further processed in field laboratories on Bikini or Enewetak. Some short-lived materials were flown back to NRDL. Some samples took days to process. He remembered a test that blew up an island and rained coral fallout on the ship's deck. When they attempted to wash it off the vessel, a coral slurry was deposited around the deck plates/rivets, making the deck look like a "checkerboard." He wasn't certain, but he believed the YAG was docked at Treasure Island when it returned to San Francisco.

He witnessed the first air delivery of a hydrogen bomb test from the YAG-40, which was located 60 miles from ground zero. He also participated in several test series at the Nevada Test Site.

By the time of the lab's impending closure in 1969, they were doing mostly "paper studies." Much latter day work was decay studies of existing samples and correlations of fallout patterns with weather predictions versus actual conditions.

One of the tests he remembered was the detonation of a 10,000-pound sphere of high explosive in the Pacific off San Clemente Island. The lab prepared a cylindrical container of a radioactive tracer that was irradiated at GE Vallecitos and placed at the center of the sphere to study the contamination spread from the blast. For this series, the lab designed small lead shipping casks with stepped lids designed to contain and prevent gamma rays from escaping and becoming a radiation hazard during shipment.

He never worked on any plutonium samples. His samples probably contained some plutonium, but only a couple of senior chemists worked on plutonium. He did analyses such as separating barium and strontium in the fallout samples to help determine the yield and efficiency of a detonated device.

He remembered getting the "cease and desist" order at the lab early in 1969. They inventoried the remaining samples, but he doesn't know what happened to them. He never worked on any animal experiments.

There were no tunnels into the hillside behind Building 815. He said there was space behind the building to park their two mobile lab trailers and the hillside was solid rock.

ROY RILEY

Mr. Riley worked as a Designer at NRDL for 13 months in 1950 and 1951 on the second floor of Building 351. After working at HPS, Mr. Riley went to work for the Air Force.

Mr. Riley was responsible for designing bismuth caps, called toadstools, for samplers used at the OPERATION DESERT ROCK tests in Nevada. He also worked with lead shielding, but did not do it in a radiation environment.

He didn't get out of his work area very often and therefore did not observe other activities at the shipyard. He did not work with radioactive material, was not trained to do so, and did not wear a dosimetry badge.

Mr. Riley does remember the arrival of a B-17 from Enewetak. He was told the plane was going to be scrapped and he could have anything he wanted from it, so long as he did not touch the motors, which were contaminated. He stripped instruments from the plane and traded them for personal use. The plane was later discarded, but he doesn't know where. He thought it might have been filled with concrete and dumped into the Bay, but had no proof of this happening, only hearsay. At least one of the planes engines was removed and shipped away from HPS for decontamination experiments.

STANLEY ROSE

Mr. Rose worked at NRDL for 8 months in 1953-54, during his time as a Hospital Corpsman in the Navy. After his time at NRDL, Mr. Rose was assigned to the hospital ship HAVEN. He considered his assignment at NRDL to be good duty.

When he reported to NRDL in 1953, Mr. Rose was assigned to a one-story building. His duty was to aid in attempts to label platelets with Sr-90. Mr. Rose did injections into rats, but did not handle radioactive materials. Dr. Roy Milne did the radioactive work.

Mr. Rose did not recall receiving radiation worker training at the lab, although he was exposed to and did handle radioactive materials. He also did not wear dosimetry. He remembered radioactive waste being separated from ordinary laboratory waste, and put into separate containers for disposal. The radioactive waste had its own special waste cart. He remembered the waste being collected by the HP group, but was unaware of what happened to it once it left the building.

Mr. Rose reported that they would coat glassware with silicone to minimize the possibility of its being contaminated by radioactivity. Glassware was hand washed.

Mr. Rose was involved in a spill on one occasion and remembers being checked for contamination by a military doctor and showering to decontaminate himself. He stated that spills were uncommon and were not treated lightly and that they were careful at the lab. They knew there was the possibility of airborne contamination, but that it was remote and not a significant problem. Therefore, the lab did not have air monitors nor did they use hoods or local ventilation. He thought the lab was crude and poorly finished.

Mr. Rose remembered that occasionally one of the laboratory's beagles would be stolen. They were purebred animals and were highly desirable as pets. The dogs were worth $50 to $75 apiece. To the best of his knowledge, they never recovered any of the stolen dogs. No contaminated animal was stolen.

Mr. Rose recalled the YAGs that were docked at HPS were not guarded and personnel would board the ships to sunbathe and drink beer.

MONTE ROWELL

Mr. Rowell worked at NRDL as a Radiochemist from 1950 to 1969. After leaving NRDL, Mr. Rowell subsequently worked for Tracerlab (later LFE Environmental), McClellan Air Force Base in the environmental lab, and Aerojet. He is currently retired.

Mr. Rowell began his career at NRDL working in Building 351. His first project was development of a simulant for fallout to be used in the testing of ship wash down systems. He settled on cobalt citrate because it wouldn't precipitate in seawater. He created a process for adding dye to the spray from the washdown system so it could be seen clearly in color films. Tests using this system were performed at the U.S. Naval Base in Guantanamo, Cuba.

When Building 815 was completed, Mr. Rowell's group moved in and occupied the sixth floor where they had their laboratory. They worked primarily on fallout samples from atomic weapons tests. Mr. Rowell prepared samples for analysis of the radioactive components. He remembered preparing plutonium samples from the weapon debris. The samples were concentrated with iron hydroxide. The basic precipitate would be dissolved in acid and plated out on platinum disks for counting; however, Mr. Rowell did not perform the counting.

Mr. Rowell used samples of radioactive isotopes duplicating the elements in fallout that were prepared by ORNL. He remembered these isotope shipments would often be significantly more radioactive than the actual fallout samples he routinely analyzed. The actual fallout samples were relatively hot when they were received, but the activity would decay quickly. He would often get called at home to report to NRDL to prepare samples that had been flown in from a weapon test before they decayed.

Mr. Rowell also recalled that cesium ion exchanging with the sodium in the glass contaminated laboratory glassware. The contaminated glass would be discarded into the radioactive waste container in the lab. The Health Physics group headed by Al Baietti collected excess samples and other radioactive waste for disposal.

Mr. Rowell remembered the health physicists at NRDL as professional and competent, and diligent about waste collection. The liquid waste was put into its own container and was neutralized before it was removed for disposal. He categorically stated that no radioactive waste was permitted to be discarded in the sink drains and that the health physicists would routinely monitor the drains. Acids and bases could not be discarded into the sink drains unless they were neutralized first. He does not know where the sinks drained.

Mr. Rowell worked at NRDL until its closure. He worked with the cleanup team, disposing of the laboratory's equipment. There were rumors that NRDL would close some time before the actual announcement was made. Laboratory employees knew it would close because the armed services, especially the Navy, stopped generating contracts. The AEC became the primary source of contracts and they were short-term.

Mr. Rowell said the Navy "trashed the place" when it was cleaned up. Valuable equipment was discarded instead of being recycled to another facility. He called the process "military politics." He, and others, suggested that the NRDL building (815) would be an ideal facility for use by the fledgling Environmental Protection Agency (EPA), but the advice went unheeded.

JAMES SARTOR

Mr. Sartor was a bombardier on B-24s and B-29s during the last stages of World War II, though he did not see combat. After he graduated from the University of Nevada in 1950, Walmer Strope, who later became head of the national Office of Civil Defense (OCD), hired him at NRDL. Mr. Sartor worked for Dr. Ed Thompson in the Technical Development Branch. His original office was on the third floor of Building 351. When Building 815 opened, his branch moved to the first floor, sharing the floor with other offices and the NRDL machine shop. Mr. Sartor left NRDL in 1962. He is currently retired.

During his career at NRDL, Mr. Sartor witnessed 80 atomic and nuclear test shots at both the Nevada and Pacific test sites. During OPERATION CASTLE BRAVO, he was aboard the USS BELL GROVE approximately 10 miles from ground zero. The yield was much higher than expected (approximately15 megatons), and the personnel on the ship were "clobbered" with fallout.

Mr. Sartor was Project Manager of experiments at Camp Stoneman to create artificial fallout to test responses to land target contamination. Simulated fallout particles of 20 to 6 microns in size were created to represent fallout at 10 to 15 miles from ground zero. The simulated fallout was tagged with radioactive lanthanum-140. They had recorders to plot time versus radioactivity called "gitters" or GTRs (gamma intensity recorders). NRDL had a hot cell at Camp Stoneman and they used it to "milk" La-140 from barium-140.

Mr. Sartor was one of the primary personnel who assisted in selecting the YAG-39 and 40 for use by NRDL. They inspected ships in the reserve fleet in the Sacramento River delta and chose these two vessels to serve as NRDL's floating laboratories. Both vessels were sent to the Long Beach Naval Shipyard for de-mothballing and placed in condition for operations. They were brought to HPS for the modifications for use in the Pacific weapons test programs. After the tests at the Pacific Proving Ground, he remembered that YAG-39 was berthed at Pearl Harbor when it wasn't being used by NRDL and YAG-40 was berthed at the HPS Gun Mole. After return from tests in the Pacific Proving Ground both YAG-39 and YAG-40 were utilized in OPERATION WIGWAM. Mr. Sartor assisted in the design of the washdown system nozzles used on YAG-39 and on other naval vessels. He was NRDL's coordinator with the shipyard for changes made to the YAGs over their careers. He assisted in the design of the shielded control room installed in YAG-39 and the helicopter flight deck on YAG-40.

Among his memories of working at NRDL and HPS, Mr. Sartor remembers evaluating various procedures for decontaminating the flight deck of the ex-INDEPENDENCE after OPERATION CROSSROADS. He said the ship was docked at the end of the Gun Mole. He remembered the residual sandblast material on the INDEPENDENCE was washed overboard to the Bay. At the time the ship was to be towed to sea and sunk, the Navy informed all Bay area facilities storing radioactive waste that they could load all their radioactive waste onto ex-INDEPENDENCE. Mr. Sartor recalled the hangar deck being stuffed full of waste containers.

Much of NRDL's laboratory-scale decontamination experiments were conducted from the barge they had on the Gun Mole. The barge was lifted from the water by the large crane and placed beneath it on the Gun Mole. Most radioactive material handling was done on the barge. There was a glove box on the barge and samples were sprayed with simulated seawater fallout.

Mr. Sartor also worked at Camp Parks. He coordinated the design and construction of the mini-fallout shelters they tested there. He was not one of the volunteers to occupy the shelter for any of the tests. He remembered using inmates from the Alameda County Prison Farm as laborers at Parks.

Near the end of NRDL's existence, Mr. Sartor stated that the OCD funded approximately 40 percent of the laboratory's work. He noted that when atmospheric nuclear testing was suspended, OCD stopped funding. The handwriting was on the wall for anyone who cared to continue their professional career at NRDL that NRDL was going to close. While there were suggestions to turn the facility into an EPA lab, nothing came of it and the lab closed.

EDWARD J. (JACK) SCHEIDEGGER

Mr. Scheidegger was a Navy hospital corpsman assigned to NRDL as an animal handler from approximately August 1966 to June 1968. He was in the Naval Reserve and was called up because of the Viet Nam war. He was assigned to NRDL.

While at NRDL, Mr. Scheidegger was assigned to work with experimental animals. He irradiated them at the NRDL x-ray machines, the Camp Parks Co-60 irradiators, and the TRIGA reactor at Lawrence Livermore Laboratory. He worked with small (mice and rats), medium (dogs), and large (donkeys, pigs, and sheep) animals, irradiating them up to and including lethal doses. He did not use radioisotopes to dose the animals.

Mr. Scheidegger participated in experiments on the animals by taking blood for special studies. He also removed spleens from anesthetized small animals after they were irradiated. Mortality for these animals was 100 percent. He remembered keeping careful notes on his work and recalled being monitored with a film badge the entire time he worked at NRDL. He also remembered being reprimanded for not turning his badge in for processing on one occasion.

Mr. Scheidegger was responsible for processing dead animals. Small animals were put in metal containers the size of small garbage cans and the large ones in 55-gallon steel drums. The large animals had to be cut up to fit in the drums. He remembered being called in to the shipyard one weekend to dispose of a donkey that had died. He and another corpsman cut the animal up with axes and packed it into drums. This was done at the NRDL kennels, probably at Building 707. The axes were washed, but he does not remember washing down the area where the animal was cut up. Mr. Scheidegger did not remove the packaged dead animals. Another group removed the animals and disposed of them. He stated they were not buried on site, to his knowledge.

Mr. Scheidegger does not recall any other use of radioactive materials at HPS. He worked on the sixth floor of Building 815. He said the work groups did not talk to each other about their work, so he wouldn't normally hear of others' radiation work. He mentioned he played baseball with other NRDLers (as they called themselves), but doesn't remember any "shop talk" among the baseball players.

His experience butchering the dead donkey convinced Mr. Scheidegger that the Navy was not to be his career choice. He left the Navy after his 2-year tour was over and went to college. He has worked in law enforcement since graduating from college.

KENNETH N. SHEPARD

Mr. Shepard was employed in the Engineering Department at Hunters Point Naval Shipyard during 1951 and 1952. His primary duties were reactivating ships from the reserve fleet for service in the Korean War.

Mr. Shepard worked for one day on the USS INDEPENDENCE installing new beams so that the ship would be seaworthy to be towed to sea for sinking in deep water. During his work on the USS INDEPENDENCE the workers wore disposable coveralls which were taped up to keep contamination from the workers. At the end of the work shift, the workers went through the decontamination building and showered prior to changing to their regular clothing. He recalled that the USS INDEPENDENCE was berthed at the end of a pier, which was one pier away from the large crane. He also recalled seeing a twin-engine aircraft on the pier near the USS INDEPENDENCE that was roped off to keep personnel from approaching the aircraft.

Mr. Shepard stated that he may have seen a barge on the gun mole pier but he was not absolutely certain of that fact. He also stated that he thought there may have been a radium dial paint shop close to the main shipyard headquarters. He believed it may have been located across the street behind the headquarters building.

Mr.Shepard stated that the lagging, etc., being removed from the ships being reactivated was put in dumpsters on the adjacent piers and then taken to the shipyard dump. He also stated that the sandblast grit used on the ships being reactivated was also put in the dumpsters and taken to the shipyard dump. He stated that the dump he spoke of was out by the south gate and that while employed at the shipyard he heard a rumor that the dump he spoke of had been there since the San Francisco earthquake of 1906.

ROBERT SULIT

Mr. Sulit worked at NRDL from 1959 until its closure in 1969. He originally was a Health Physicist who headed the Radiological Development Branch of the Health Physics Division. He later went to the Military Evaluation Division. Mr. Sulit was also a Navy Reserve Officer and was appointed the last acting Commanding Officer of NRDL after most personnel were gone.

Mr. Sulit developed a multi-curie Sr-90 disc source for irradiating the skin of rats to simulate fission product exposure. The work was done in the radioactive material storage area on the first floor of Building 815, using an absolute-filtered glove box covered with 2 inches of lead shielding. The source was 1-inch-thick by 2 to 3 inches in diameter and was placed in a lead-lined storage container after fabrication. To make the source liquid, Sr-90 solution was mixed into “dental stone” (a casting plaster) in a rubber bowl and poured/scraped into a mold. The dental stone powder, rubber bowl, and spatula were obtained from the HPS Dental Office. Several dry-runs were done before the liquid Sr-90 solution was used. Mr. Sulit wore dosimeters and film badges on his chest and film badges on his arms just above the wrists. There was no radiation overexposure or personnel contamination on the first test run. Mr. Sulit does not remember the readings, but no overexposure reports were required. The waste residue from the mixing materials, personnel protection gear, and the glove-box lining were placed in a 5-gallon covered waste container and then in a concrete-lined 55-gallon barrel for burial at sea.

Mr. Sulit was also very familiar with the Chairman of the Radioisotope Committee, Mr. Al Baietti, and the Radiation Safety Officer, Mr. Al Smith. He stated that both individuals strictly enforced the radiation safety program and that it was a very effective program.

Mr. Sulit, along with Mr. Edward Leahy and Mr. Baetti, authored the three-volume publication entitled "Principles of Radiation and Contamination Control."

Mr. Sulit, Mr. Leahy plus one other individual, whose name he could not remember, conducted the closure survey for Building 815 after closure. Mr. Sulit remembers using alpha monitors with a Nuclear Chicago Model 2111 (air proportional probe); measuring beta-gamma with an Eberline Model E-112 Geiger-Mueller counter and an AN/PDR-27.

ROBERT L. SUMMERS

Mr. Summers began employment at HPS on 7 February 1944, as an apprentice woodworker in the HPS Apprentice Program. He remained employed at HPS until 1973, when the shipyard closed (it actually closed in 1974). During his tenure, he worked himself up from the apprentice level to head of the Woodworking Shop. Boat builders, joiners, shipwrights, and wood caulkers were the trades he supervised.

Mr. Summers remembered that NRDL's first buildings were six or seven small buildings in the "500 area" where the buildings have since been razed. These buildings were located where the motor whaleboats are presently sitting, east of the railroad trains next to the NWT trailers. He recalled NRDL's second location as Building 366 and their last location as Building 815.

Mr. Summers had limited contact with NRDL; however, when they were in the 500 series buildings he did work on some building shelves, etc. He stated that they did have some areas posted to keep workers out.

Mr. Summers was not knowledgeable of where a radioluminescent paint shop or booth may have been; however, he stated that he remembered a cascade waterfall-type booth in Building 253 that may have been the location.

Mr. Summers stated that the USS GEORGE EASTMAN (YAG-39) and USS GRANVILLE HALL (YAG-40) were moored on the north side of the large crane. He also stated that the change-out building for work on the YAGs was the second building east of the railroad trains, adjacent to the NWT trailers.

Mr. Summers remembered the USS INDEPENDENCE being moored at Berth 4.

Mr. Summers remembered that in the 1950s radioluminescent markers were disposed of in the area of the oil ponds.

Mr. Summers stated the shipyard main gate used to be inside of the present location, approximately just past the building designated as the employment office.

Mr. Summers stated that he believed that the white powder found in the forge was called "sal ammoniac" and that it was used to shape forged materials and clean soldering irons.

Mr. Summers stated that the tower on the large crane was used in conjunction with bungee cords to catch dummy POLARIS missiles so that they could be reused. Missiles were launched from a barge on the south side of the Gun Mole Pier into the tower.

Mr. Summers stated that the large drydock had been planned to be longer in the direction of the hill. However, because of the density of the rock, they had to settle for the present length.

Mr. Summers lived close to the shipyard but did not recall a tunnel into the hill on shipyard property. He did say that as a young boy he used to play in a tunnel in the hill off shipyard property that was maintained by a water company. That tunnel was off Evans Avenue before you approached the shipyard property.

Mr. Summers stated that the area south of the big crane was all water and was constructed of landfill material.

On a tour of the shipyard during the interview, Mr. Summers identified the following buildings and associated shops:

- *Building 363* – Woodworking Shop
- *Building 351* – Originally Electronics Shop, with the tower used for periscopes before Building 253 was built
- *Building 411* – Shipfitter Shop
- *Building 439* – Sheet Metal Shop
- *Other "400" Buildings* – Supply Department
- *Building 272* – Riggers Shop
- *Building 253* – Electrical and Electronics Shops
- *Building 225* – Woodworking Shop (used one-half of the building)
- *Building 211* – Original Shipfitter Shop
- *Building 231* – Inside Machine Shop
- *Building 214* – Supervisor of Shipbuilding and Repair (SUPSHIP) and Planners
- *Building 238* – Outside Machine Shop

FRANK TAFORO

Mr. Taforo was hired at NRDL in the summer of his junior to senior year in high school, probably 1963. He got the job because Mr. Val Franz, an NRDL employee and neighbor, suggested to his mother that he apply for summer work at the lab. He remembers being paid well for a 16 year-old. His salary was about $1.00 per hour more than the minimum wage of the time.

He originally contacted the Navy about his experience at NRDL because of concerns about his potentially receiving radiation exposure during his time of employment. Mr. Taforo was assured that his radiation dose was probably negligible and not a concern.

Mr. Taforo was assigned as an animal keeper in Building 815, which he refers to as “the lead-lined building.” He was assigned to work with large white rats that were about 1 foot long, including their tails. His primary duty was cleaning the rats’ cages. He was not supervised. He was responsible to clean about three to four rooms of rat cages per day. There were 10 racks with 100 cages per rack, for a total of 1,000 cages per room. There were tens of thousands of rats in Building 815. He learned to clean the cages quickly.

Mr. Taforo considers the rat duty to have been the most pleasant of his duties. The rats were generally cleaner and healthier looking than other animals and cleaning their cages was much less messy. He took the rats out of the cages, removed the wood chips and feces, put the waste into plastic bags that were collected by others, and refilled the animals’ water bottles. He has no knowledge of how waste was disposed of once it left the lab.

If a rat escaped from its cage during the cleaning, the cleaners were required to kill the animal because it was considered contaminated by the environment outside the cage. To kill the rats, the cleaners hit their heads against the cage/rack. Some workers drowned the rats, but when Mr. Taforo tried drowning them, he found the process too slow. He remembers that the old-timers had an efficient technique for dispatching escaped rats. They would allow the rat to run about 3 feet from its cage, and then grab it by its tail, flipping its head against the rack and tossing the dead animal at the wall so it bounced into the trash container in one motion. The dead animals were put into the trash. Other personnel collected the trash containing the dead animals. Mr. Taforo has no knowledge of how the animals were disposed of once they were removed.

Mr. Taforo also worked 1 or 2 days cleaning dog cages in rooms he characterized as “a mess.” The dogs were beagles or other similar size breeds. The disposal of the dogs’ waste products was not controlled and they were washed down the floor drains. He remembers this as a particularly unappealing experience as he was hosing down the cages, and the drains were clogged and there were feces and blood in the 6 inches of water that covered the floor.

The dogs were in various states of ill health as many had been dosed with lethal doses of radiation. Many were dying and jaundiced. Some were partially shaved and had stitched up wounds. Some of the dogs had had holes cut into their skulls. The holes were plugged with some type of corks. He believes that he performed so poorly at the dog cage cleaning that he was not assigned the task again.

Mr. Taforo remembers a large collection of sheep at the site that were also in various states of poor health, including some that had been shaved, had stitched wounds, and had a general look of jaundice. He only worked with sheep on one weekend. The sheep were not kept in 815, but were in another building near 815. He does not recall the building number.

Mr. Taforo received no training. He wore a badge while he was at work that he believes was for monitoring radiation and was probably a film badge. He remembers passing through a monitor to enter and exit Building 815. However, he was not allowed into any of the laboratories within Building 815.

Mr. Taforo recalled that radios did not work in Building 815. The seventh floor of the building contained a cafeteria, and he ate there a couple of times, but he brought his lunch most of the time.

He considers the lack of training at the laboratory and the messy condition of the facility to have been significant failures on NRDL's part.

JAMES WATSON

Mr. Watson worked for various shops at HPS from 1943 to 1974. He began working at the shipyard as a general laborer during World War II. After his first 4 years of employment, he began to do sandblasting. He remained a sandblaster until HPS closed in 1974. He worked primarily in Shop 71, Building 270.

Mr. Watson remembers working on at least two LSTs from OPERATION CROSSROADS. Sandblasting on vessels with radioactive contamination required changing into protective clothing, including coveralls, gloves, and shoe covers. Mr. Watson remembers changing clothes when he arrived at work in the morning, showering and changing into his street clothes at lunch, changing back into protective gear after lunch, working until 1500 hours, then showering and changing before going home. Two monitors would check them after showering and if they showed any residual activity, they had to shower again. He recalls showering up to three times, including a brush scrubbing, before being allowed to dress.

Mr. Watson does not recall receiving any special training to work on the radioactively contaminated vessels. They wore an air-fed hood and were not permitted to smoke on the vessels. When they were not wearing their hoods, they had to wear respirators. They were required to wear gloves at all times they were on the ships. He remembers the sandblasting to be hard work under less than ideal conditions. The sandblast grit also contained pieces of paint.

The grit would blow toward the Bay, but, occasionally, the wind would blow it back over the base. Blasting would not stop because the wind changed direction.

The sandblast grit was picked up and put into drums for disposal. He has drummed grit and recalled the drums being capped with concrete before being hauled to sea for burial. He also remembered disposal of grit in the landfill. Bulldozers would dig a trench, and the grit and other trash would be put in the trench. The trench would be covered with dirt after it was filled.

Mr. Watson also worked on other than OPERATION CROSSROADS ships. These included the USS ENTERPRISE, where a Marine accompanied him while working on the ship, and many small vessels were docked at the Gun Mole for sandblasting.

He also worked on a lot of submarines, some of which were nuclear-powered. Workers were permitted to take their families on vessels on which they worked. However, this did not include the nuclear-powered ones.

Shipyard employees were told several years before disestablishment that the yard was going to close. Bethlehem rented some docks from the Navy before the yard closed. When closure finally came, skip boxes were brought in, and he helped fill them with tools and materials. The boxes were dumped in the landfill and buried. Three to four trucks were also filled daily with tools and equipment and shipped to other bases. Buildings were locked when they were cleaned out. This process took about 2 months.

The yard was a dangerous place to work. They steamed out ships and hauled the residue, presumably not radioactive, to the landfill for burial. However, the steam solution contained caustic soda. One of the containers of this solution was above Mr. Watson and about 20 to 25 of his fellow workers in a drydock. The container failed and bathed the men in the caustic soda solution. Mr. Watson was in the hospital for 31 days. He had gotten some of the soda in his eyes. One of his co-workers was not so lucky: he was blinded in the accident.

Mr. Watson also witnessed a rigger being crushed by a falling rudder. The rudder was braced and the bracing failed. The rudder fell on the rigger and crushed him from below the knees up.

FRANK WENSLAWSKI

Mr. Wenslawski was employed at NRDL in Building 815 from 1967 through 1968.

He worked on developing personnel dosimetry. In this work, he used a sealed Co-60 irradiator, the Van de Graaff accelerator, and x-ray machines.

His recalled the Radiation Safety Committee and the RSS staff maintained positive control of the use of radioactive materials and radiation-producing machines.

DR. ALBERT WILEY

Dr. Wiley was the last Medical Director at NRDL. He worked there from July 1968 to August 1969.

Dr. Wiley completed the only NRDL Technical Report using the Cyclotron, NRDL Technical Report No. 69-88 entitled *Effects of Fast Neutrons and X-Rays on Rapidly Labeled RNA Synthesis in Regenerating Mouse Livers*.

Dr. Wiley stated that the work being done at NRDL was extremely valuable research. When they were informed that NRDL would close in December 1969, he and the Commanding Officer went to Washington to try and convince the CNO that NRDL should remain operational because of the vast pool of scientists and the valuable contribution they were making to science.

Dr. Wiley stated that he regularly went to the Nuclear Weapons School in San Diego to lecture on the effects of nuclear weapons. He also confirmed that NRDL had a response team prepared to respond to worldwide nuclear accidents.

Dr. Wiley recalled that NRDL's Radiation Safety Committee and the RSS staff maintained a strong program of radiation safety at NRDL at all times.

ROBERT WILSON

Mr. Wilson ran the Cyclotron facility from January 1966 to October 1969.

He stated that the Cyclotron was used for some experiments using deuterons only. However, it was never operational for proton production. The Cyclotron was only used at low power and was never fully operational because of a fatal flaw in the magnetic system. Isotopes were never produced with the Cyclotron.

RICHARD WOLF

Mr. Wolf stated that radiological work only was done at HPS by organizations with a license to do so, and he only recalled MINS doing work there.

Mr. Wolf believes the first NNPP ship that went to HPS for maintenance was in the late 1980s and could have been the USS ENTERPRISE, CALIFORNIA, or ARKANSAS. He does not recall any spills at HPS.

Drydock 4 and some surrounding buildings were used for work on ENTERPRISE and CALIFORNIA. He wasn't sure, but they might also have been used for LONG BEACH and BAINBRIDGE. Work started in the 1992-1993 time frame and the drydock was surveyed in

1994. The release survey report was written in 1995. A supplement to the survey was written after the release report.

Mr. Wolf did not recall any radioactive materials spills at HPS. MINS barged radiological waste and returned it to MINS.

APPENDIX B
TABLES

TABLE B-1
HRA INTERVIEWS

Start Date of Employment	End Date of Employment	Employer	Location of Work	Position	Current Location
Unknown	Unknown	Navy	Mare Island	EOD Officer	Unknown
Unknown	Unknown	Navy	HPS	Unknown	Unknown
Unknown	Unknown	Navy	Mare Island	Unknown	Unknown
Unknown	Unknown	Navy	Unknown	Unknown	Unknown
Unknown	Unknown	Navy	Unknown	Big graving dock (Drydock 4)	Unknown
N/A	N/A	Civilian	HPS	Sea Scout in early 1960s	Unknown
N/A	N/A	Civilian	Did not work at HPS	None	Unknown
1952	1969	Navy	NRDL	Division Head	Unknown
1957	1969	Navy	NRDL	Health Physicist	Unknown
1959	1969	Navy	NRDL	Health Physicist	Unknown
1959	1967	Navy	NRDL Building 815	Electronics Engineer	Unknown
1960	1965	Navy	NRDL Building 815	Radiochemist	Unknown
1966	1969	Navy	NRDL	Cyclotron Operator	Unknown
1967	1968	Navy	NRDL Building 815	Dosimetry Developer	Unknown
1967	1969	Navy	NRDL	Corpsman/Animal Keeper	Unknown
1968	1969	Navy	NRDL	Medical Director	Unknown
1968	1969	Navy	NRDL	Scientist	Unknown
1961	1986	Navy	Mare Island	Engineer/Supervisory Engineer	Unknown
1962	1962	Navy	NRDL	Summer Student Employee	Unknown
1962	1962	Navy	USS JOHN R. CRAIG	Unknown	Unknown
1963	1982	Navy	HPS	Radiographer	Unknown
1981	1996	Navy	Mare Island	Code 300	Unknown
1981	1996	Navy	Mare Island	Unknown	Unknown
1983	1995	Navy	Mare Island	Rad Control	Unknown
1949	Unknown	Navy	Original Lab Building	Unknown	Unknown
1962	1996	Navy	Mare Island	Director, Code 105	Unknown
Mid-1970s	1996	Navy	Mare Island	Head, Code 105.3	Unknown
1971	1973	Navy	On ships, in yard	Ship Superintendent	Unknown
1949	1949	Navy	HPS	Machinist	Unknown
1953		Navy	NRDL	Lab Head	Unknown
1959	1959	Navy	NRDL	Math Intern	Unknown
1988	1992	Triple A	Everywhere in yard and on some vessels	Painter	Unknown
1974	1980	Triple A	On ships	Laborer	Unknown
1975	1984	Triple A	Everywhere there were ships	Marine Electrician	Unknown
1943	1968	Navy	NRDL	Unknown	CA
1951	1952	Navy	Building 351	Designer	Alameda, CA
1939	1942	Father's Tool and Die Shop	Father's Shop	Helper	Alameda, CA

TABLE B-1
HRA INTERVIEWS

Start Date of Employment	End Date of Employment	Employer	Location of Work	Position	Current Location
		Triple A	HPS		Albuquerque, NM
1951	1955	Navy	Ships and docks	Rigger	American Canyon, CA
1969	1973	Navy	Drydocks/ships/shops	Pipefitter	Americus, GA
1996	1997	Navy	HPS	Asbestos Removal	Antioch, CA
1965	1969	Navy	HPS	Pipefitter	Astoria, OR
1950	1952	Navy	NRDL Kennels	Hospital Corpsman	Atascadero, CA
1952	1969	Navy	NRDL	Scientist	Bainbridge Island, WA
1963	1973	Navy	Building 113	Metal fabrication division head-QA	Bass Lake, CA
1948	1972	Navy	All over	Electrician Helper, Painter Apprentice, Engineering Tech.	Belmont, CA
1951	1952	Navy	Drydocks, piers	Engineer Foreman	Benton, AR
1963	1969	Navy	NRDL	Nuclear Physicist	Berkeley, CA
1963	1967	Navy	Dental Clinic	Dental Technician E-3	Berkeley, CA
1955	1957	Navy	Shipyard/Building 815	Intern for summers	Berkeley, CA
1951	1970	Navy	Shipyard	Chief of Police	Berkeley, CA
1957	1959	Navy	NRDL	Summer help: Supervisor of coop students	Bethesda, MD
1958	1973	HPS	Drydocks and NRDL	Shipwright/Rad Con Tech	Brisbane, CA
1979	1995	Triple A	All over shipyard	Rigger/Welder Helper/Boilermaker	Burlingame, CA
1961	1964	Navy	All over	Teacher	Burns Lake, BC
1950	1969	Navy	NRDL animal facilities	Biologist	Capitola, CA
1961	1967	Navy	On ships	Electrician	Ceres, CA
1952	1963	Navy	NRDL	Experimenter	Carmichael, CA
1950	1950	Navy	On ships	Engineering Officer	Citrus Heights, CA
1978	1987	Navy	San Bruno-Southwest Division	Facilities Planner	Citrus Heights, CA
1978	1984	Triple A	Building by Drydock 3	Machinist	Clear Lake Oaks, CA
1955	1958	Navy	Shipyard	Shipyard Commander	Coronado, CA
1975	1984	Triple A	All over	Electrician	Cotati, CA
1996	2001	Astoria Metal Corp. (AMC)	Drydock 4	Hazardous Material Technician	Daly City, CA
1943	1969	Navy	Shipyard 1943-1950 NRDL 1950-1969	General Engineer	Daly City, CA
1943	1957	Navy	Drydocks	Machinist	Daly City, CA
1945	1967	Triple A	All over HPS	Electrician	Danville, CA
1986	1986	Navy	USS ENTERPRISE	Electrician/Nuclear Technician	El Cerrito, CA
1951	1969	Navy	NRDL	Assistant Director of Life Sciences, Bio-Med Div	El Cerrito, CA
1949	1973	Navy	Shop 64	Apprentice Boat Builder	El Dorado Hills, CA

TABLE B-1
HRA INTERVIEWS

Start Date of Employment	End Date of Employment	Employer	Location of Work	Position	Current Location
1948	1948	Navy	Physics Lab Building	Librarian	El Sobrante, CA
1946	1947	Navy	Shipboard	Optical shop	Elk Grove, CA
1952	1972	Navy	Shop 72	Rigger	Emeryville, CA
1946	1947	Navy	USS ROCKWELL	Cook	Fair Oaks, CA
1966	1968	Navy	NRDL	Hospital Corpsman	Fair Oaks, CA
1965	1969	Navy	NRDL Building 707	Animal Keeper	Fair Oaks, CA
1941	1945	Navy	Unknown	Project Engineer	Folsom, CA
1948	1949	Tourist	All over	Child for Navy Day	Foster City, CA
1951	1969	Navy	NRDL	Biomedical Researcher	Fredericksburg, VA
1951	1969	Navy	NRDL	Radiochemist	Fredericksburg, VA
1943	1950	HPS	Drydocks	Equipment Specialist	Fresno, CA
1942	1943	Navy	Various	Journeyman Rigger	Hayward, CA
1971	1973	Navy	On ships, in shop	Pipefitter	Hayward, CA
1973	1995	Naval Public Works Center	Different buildings	HVAC Mechanic, Planner-Estimator	Hayward, CA
1950	1951	Navy	HPS	Electrician	Holiday Island, AR
1947	1947	Navy	On contaminated ship	Ensign-Rad Trainee	Hollister, CA
1960	1963	USMC	NRDL	Head of Naval Radcon Team	Kaneohe, HI
1954	1973	Navy	YAGs	Sandblaster	Long Beach, CA
1955	1970	Self	Hunters Point	Outside PR Firm	Los Altos, CA
1953	1954	Navy	Dental Clinic	Dental Technician	Mendocino, CA
1942	1972	Navy	Shipyard	Progress Manager	Mesa, AZ
1950	1962	Navy	NRDL	Project Engineer	Mt. Shasta, CA
1961	1995	Navy/MINS	Drydocks, ancillary sites	Machinist, Refueler, QA Officer, Auditor	Napa, CA
1951	1952	Navy	NRDL buildings	Experimental Physicist	Nevada City, CA
1987	1991	Navy	Alameda	Environmental Protection Technician	Newark, CA
1945	1947	Navy	Main Ops	Router/Classifier of Incoming Mail	North Highlands, CA
1944	1974	Navy	Drydocks and piers	Sandblaster	North Highlands, CA
1959	1960	Sunset Scavenger	Everywhere in yard	Truck Boss	Oakdale, CA
1957	1969	Navy	NRDL Building 815	Physics Experimenter	Oakland, CA
1963	1974	Navy	Shipboard	Welder/Shipfitter	Oakland, CA
1951	1969	Navy	NRDL	Chemical Analyst	Oakland, CA
1972	1984	Navy/Triple A	All over yard	Laborer	Oakland, CA
1985	1995	Triple A	All over yard	Sandblaster	Oakland, CA
1972	1975	Triple A	All over yard	Laborer	Oakland, CA
1994	2001	IT-Ohm	Next to gate	Senior Recovery Technician	Oakland, CA

TABLE B-1
HRA INTERVIEWS

Start Date of Employment	End Date of Employment	Employer	Location of Work	Position	Current Location
1965	1974	Navy	USS ENTERPRISE	Marine Machinist	Oakland, CA
Unknown	Unknown	NCRP	NRDL; attended meetings there	National Academy of Science Advisory Committee on Civil Defense	Oak Ridge, TN
1952	1973	Navy	Drydocks and berths	Sheet Metal Foreman	Pacifica, CA
1942	1953	Navy	NRDL	Electrician Apprentice	Palo Alto, CA
1953	1960	Navy	NRDL	RAD Safety Officer	Palo Alto, CA
1967	1999	Navy	Stanford Research Institute-NRDL	Researcher	Palo Alto, CA
1963	1970	Navy	Medical Department	Hospital Corpsman	Petaluma, CA
1951	1957	Navy	NRDL	Rad Safety Engineer	Placerville, CA
1951	1951	Army	Enewetak Atoll	Test Observer	Portland, ME
1954	1956	Navy	NRDL	Intern	Pt. Reyes Station, CA
1952	1954	Navy	NRDL Building 815	Physicist	Raleigh, NC
1967	1975	Navy	All over yard	Maintenance/Public Works	Redwood Valley, CA
1959	1960	Navy	Submarines	Outside Machinist Helper	Reno, NV
Unknown	Unknown	Navy	Bikini Test Site	Warrant Officer	Resque, CA
1968	1972	Navy	NRDL, Shipyard	Secretary, Executive Assistant	Reston, VA
1967	1969	Navy	NRDL	Lieutenant in Bio-Assay	Richland, WA
1978	1979	Triple A	Drydocks	Marine Electrician Helper	Richmond, CA
1964	1973	HPS	Shop 11	Pneumatic Tool Operator	Richmond, CA
1966	1970	Navy	Drydocks and berths	Shipfitter	Richmond, CA
1967	1973	Navy	Shop 56, on ships	Pipefitter-Shop 56	Richmond, CA
Unknown	Unknown	Navy	MINS	Unknown	Roseville, CA
1953	1954	Navy	RADLAB	Hospital Corpsman	Roseville, CA
Unknown	Unknown	Navy	MINS	Unknown	Sacramento, CA
1963	1972	Navy	Various	Painter	Sacramento, CA
1942	1952	Navy	RADLAB and NRDL	Active Duty Navy	Sacramento, CA
1951	1955	NRDL	Animal Facilities	Radiation Chemist	Sacramento, CA
1968	1969	Navy	NRDL	Hospital Corpsman	Sacramento, CA
1951	1952	Navy	All over, primarily Drydocks and berths	RAD Control Technician	Sacramento, CA
1971	1973	Navy	Ships in yard	Ship Superintendent	Sacramento, CA
1952	1969	Navy	Piers	Crane Operator	Sacramento, CA
1989	1994	Navy	Shipyard	Port Operator	Sacramento, CA
1969	1971	Navy	Everywhere in yard, on ships	Maintenance Technician E-4	Sacramento, CA
1950	1969	Navy	NRDL Building 815	Radiochemist	Sacramento, CA
1960	1962	Navy	Shipyard	Bookkeeper	Sacramento, CA

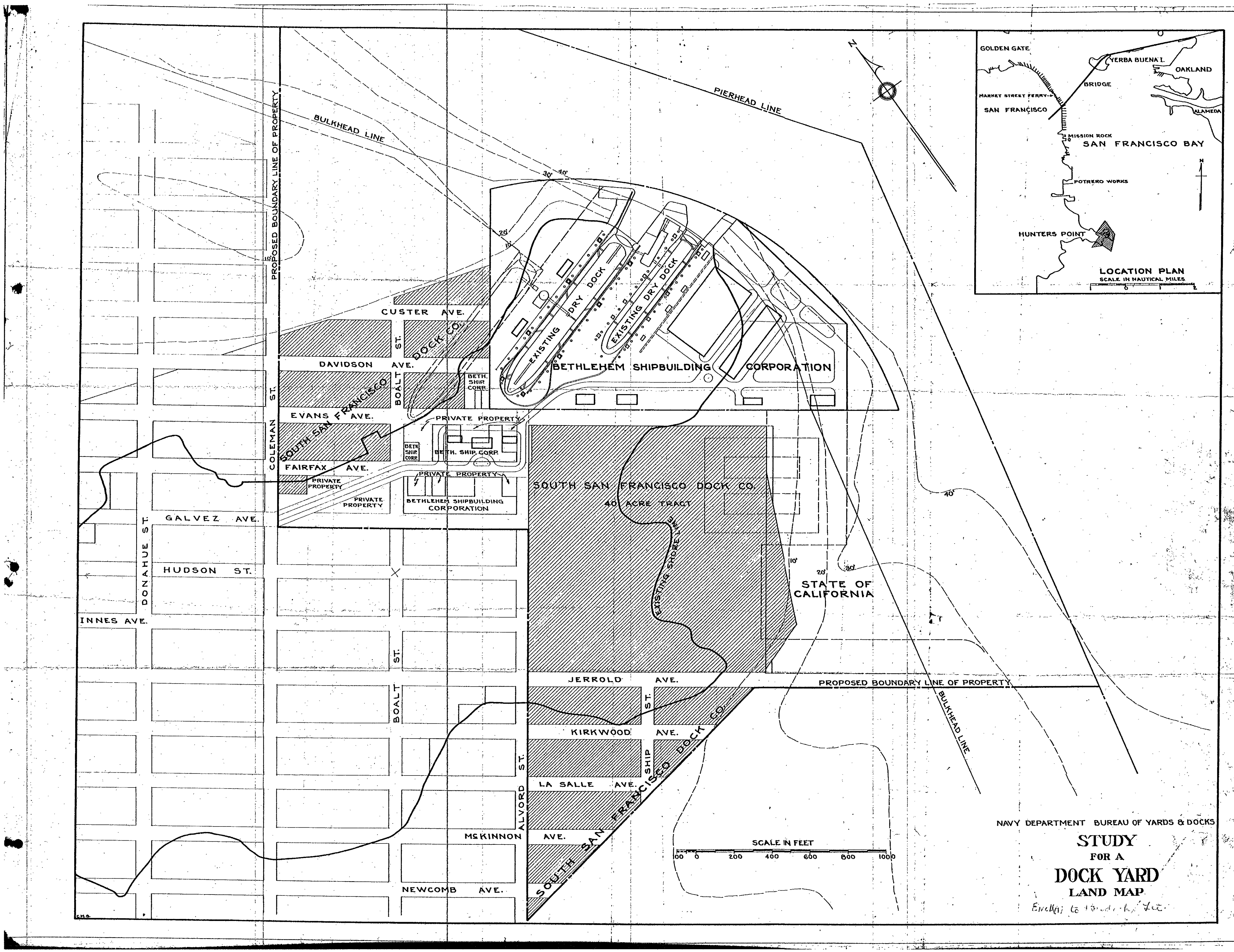
TABLE B-1
HRA INTERVIEWS

Start Date of Employment	End Date of Employment	Employer	Location of Work	Position	Current Location
1985	1985	Navy	Drydocks and laboratories	Rad Technician	Sacramento, CA
1941	1948	Navy/MINS	MINS	Machinist	Sacramento, CA
1961	1972	Navy	Shipyard	Helper Electrician	Salinas, CA
1957	1969	Navy	Waterfront and Building 815	Scientist	San Diego, CA
1949	1969	Navy	NRDL Building 351, then 815	Assistant to Technical Director	San Diego, CA
n/a	n/a	Civilian	Did not work at HPS	Community Activist	San Francisco, CA
1949	1978	Navy	Building 363	Woodworker	San Francisco, CA
1980	1980	West End Design/Bay Habitability	Building 401	Sheet metal worker	San Francisco, CA
1949	1978	Navy	YAGs and INDEPENDENCE	Sandblaster	San Francisco, CA
1952	1959	Navy	Special services building	Bookkeeper	San Francisco, CA
1963	1963	Navy	NRDL Building 815	Animal Keeper (Summer)	San Francisco, CA
1986	1995	Navy	MINS/HPS and Aircraft Carriers	Radiation Control	San Francisco, CA
1986	1995	Navy/MINS Code 105.3	Drydocks	Radiation Control Tech	San Francisco, CA
1992	1996	Navy	Drydocks and piers	Laborer	San Francisco, CA
N/A	N/A	Self		Family Member	San Francisco, CA
1952	1959	Navy	Special Services	Temporary contract employee	San Francisco, CA
1976	1979	Triple A	All over	Machinist	San Francisco, CA
1967	1971	Navy	Drydock 4	Rigger	San Francisco, CA
1970	1980	Bekins Movers	All over	Driver	San Francisco, CA
1976	1979	Triple A	Docks and berths	Machinist	San Francisco, CA
2000	2001	IT	All over yard	Field Tech/Laborer	San Francisco, CA
1947	1969	Navy	NRDL	Radiochemist	San Francisco, CA
1976	1986	Triple A	All over	Painter	San Francisco, CA
N/A	N/A	Self	Never at HPS	Photographer	San Francisco, CA
2003	2003	Tenant on HPS	Building 364	Inorganic Chemist	San Francisco, CA
1967	1971	Navy	Drydocks	Rigger	San Francisco, CA
1976	1986	Triple A	All over	Painter	San Francisco, CA
1950	1968	Navy	NRDL, all over	Civil Engineer	San Leandro, CA
1945	1946	Navy	All over the bay	Tug Master	San Mateo, CA
1941	1951	Navy	Recruitment office	Clerk	San Mateo, CA
1950	1969	Navy	NRDL	RADIAC Designer	San Mateo, CA
1956	1969	Navy	Building 815	Supervisor	San Mateo, CA

TABLE B-1
HRA INTERVIEWS

Start Date of Employment	End Date of Employment	Employer	Location of Work	Position	Current Location
1948	1973	Navy	Medical facilities	Industrial Optometrist	San Rafael, CA
1944	1946	Navy	Shop 31	Typist	Santa Rosa, CA
1946	1946	Navy	Bikini Atoll	Diver	Severna Park, MD
1963	1966	Navy	Building 815	Duty Officer	Silver Spring, MD
Unknown	Unknown	Unknown	Unknown	Unknown	S. San Francisco, CA
1957	1959	Navy	NRDL	Hospital Corpsman	S. San Francisco, CA
1952	1975	Navy	Shop 51	Electrician/Foreman	S. San Francisco, CA
1975	1978	Bethlehem Steel	All around HPS, primarily Drydock 4	Rigger	S. San Francisco, CA
1959	1962	Navy	NRDL	BUSHIPS Program Officer	Sparks, NV
1974	1976	Rough 'n Ready Island	Stockton	Machine Rigger	Stockton, CA
1961	1964	Navy	Building 815	Bacteriologist	Vacaville, CA
1990	1992	File Safe	Building 815	Data Card Reader	Vacaville, CA
1956	1963	Navy	Drydocks and ships	Electrician	Vacaville, CA
1962	1962	Navy	USS JOHN R. CRAIG, DD885	Animal Handler	Vacaville, CA
1992	1994	Navy	Drydock 4	Unknown	Vacaville, CA
1943	1950	HPS	Building 101	Head Progressor, Labor Relations Supervisor	Vallejo, CA
1948	1949	Contractor	All over	Contractor	Walnut Creek, CA
1967	1970	Navy	Shipfitter shop	Shipfitter	Windsor, CA
1960	1963	Navy	Boiler Shop	Boiler Maker	Yolo, CA
1981	1985	Purewater	Unidentified aircraft carrier	Operator	Yountville, CA
1972	1973	Collins Electrical	All over site	Project Manager	Yuba City, CA

APPENDIX C
HISTORICAL DRAWINGS AND PHOTOGRAPHS



Not to Scale

Notes:

Image shown per Map ID 503.

Hunters Point Naval Shipyard
San Francisco CA

Historical Radiological Assessment

January, 2004

New World Technology
448 Commerce Way, Livermore CA 94550
Phone (925) 443-7967 Fax (925) 443-0119

SAGE Consultants, Inc.
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Tel. (805) 482-6088 * Fax (805) 389-9815
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Figure C1

Dock Yard - Circa 1935

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1942 Aerial Photo

Figure C2

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SAGE Consultants, Inc.
LAT 34°-13'-00"N LONG 119°-02'-40"W ELEV 53.430m
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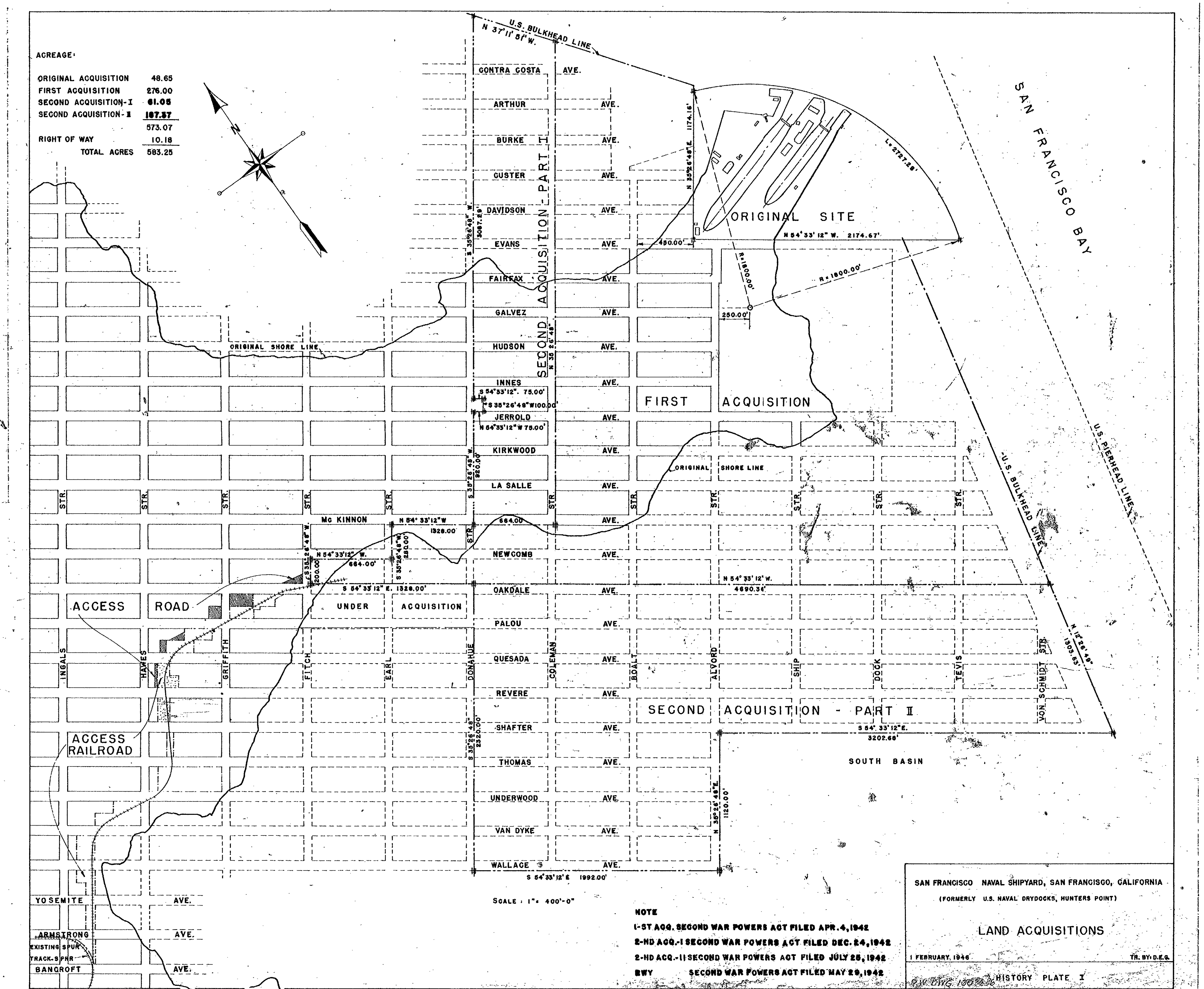
1945 Aerial Photo

Figure C3



Not to Scale

Notes:

Image shown per Map ID 562.

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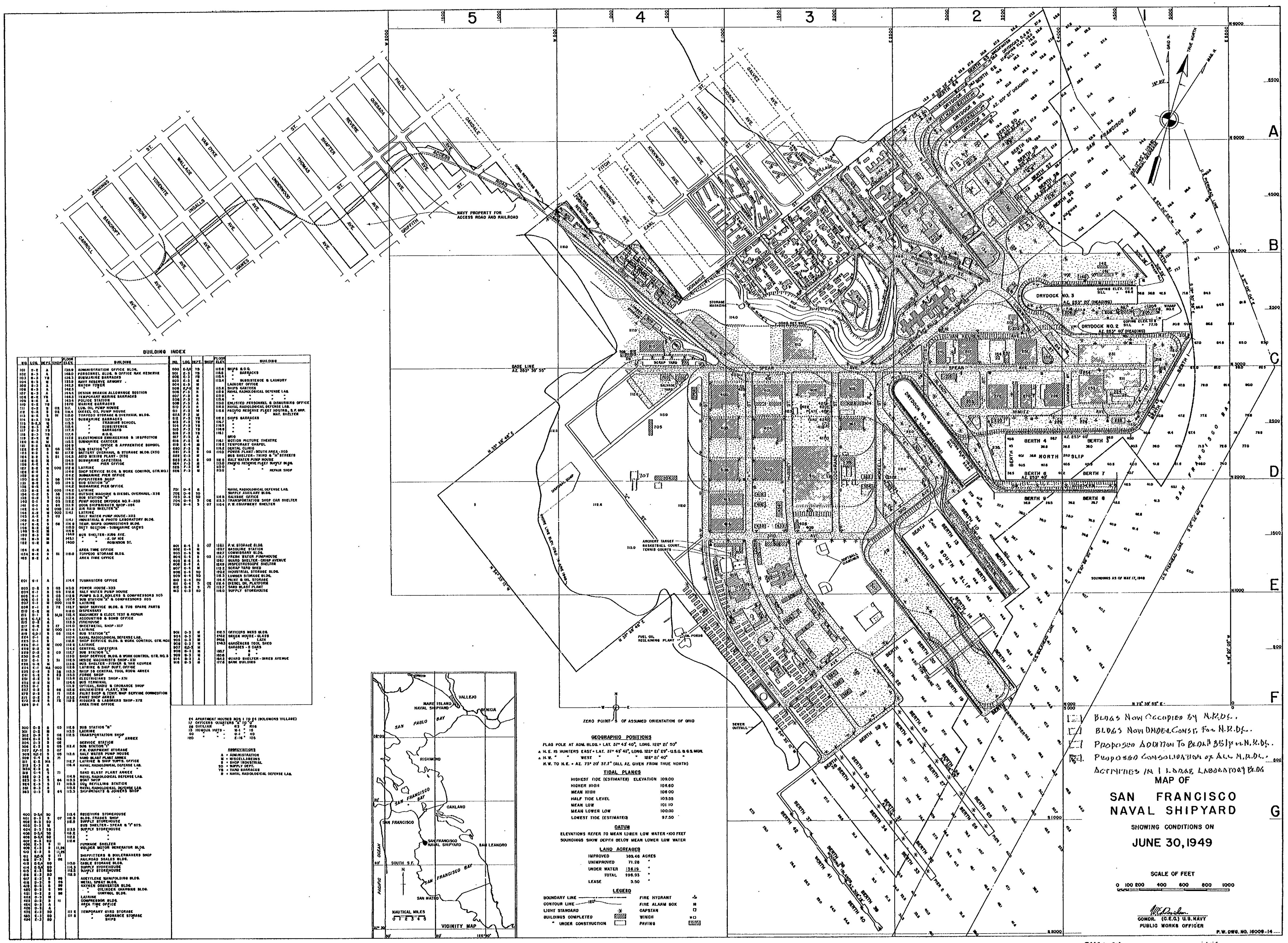
Figure C4
Acquisition Map - Circa 1946



Not to Scale

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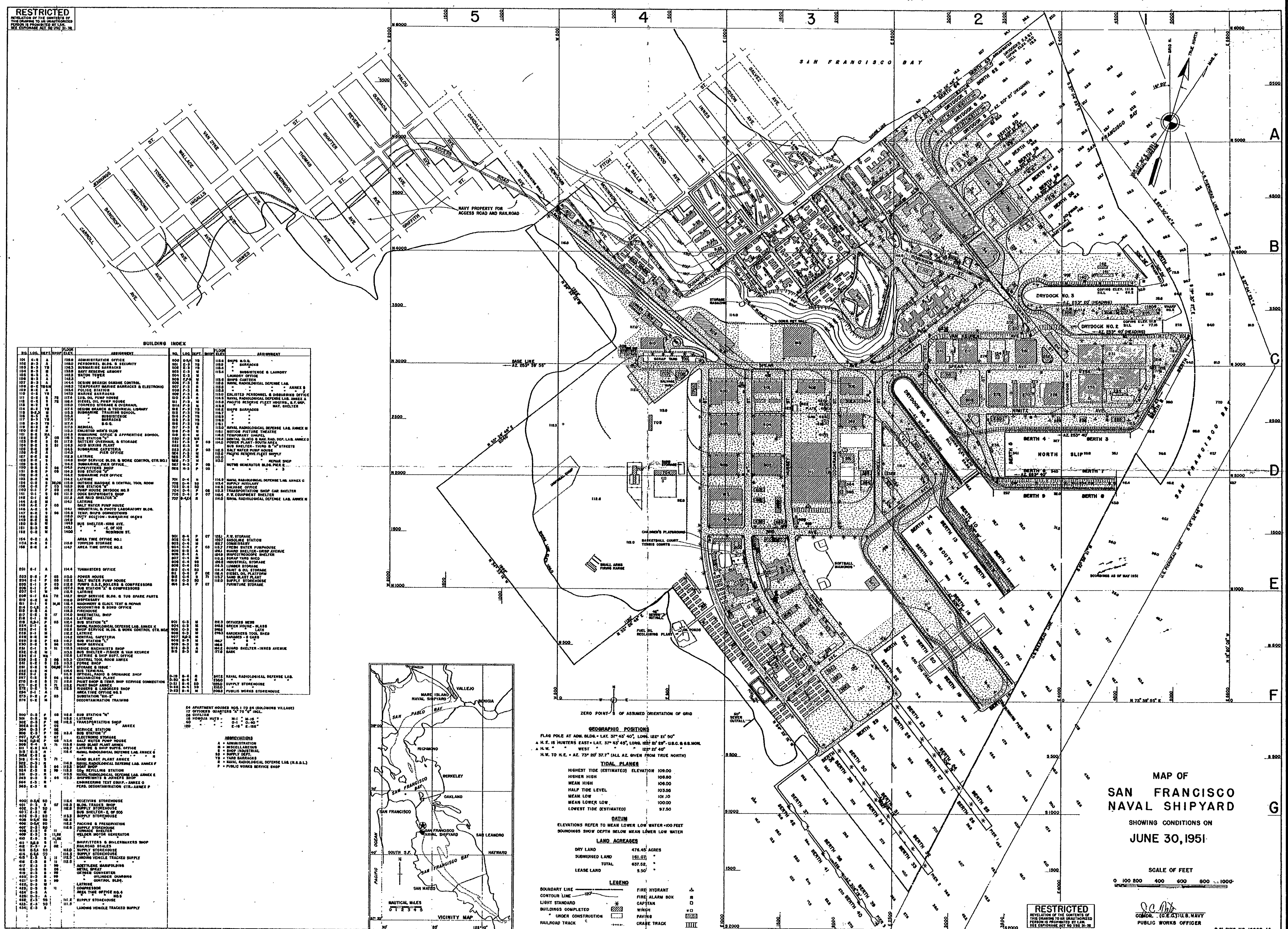
Figure C5
Site Map - Circa 1949

RESTRICTED SECURITY INFORMATION

12–16



Not to Scale

Notes:

Image shown per Map ID 316.

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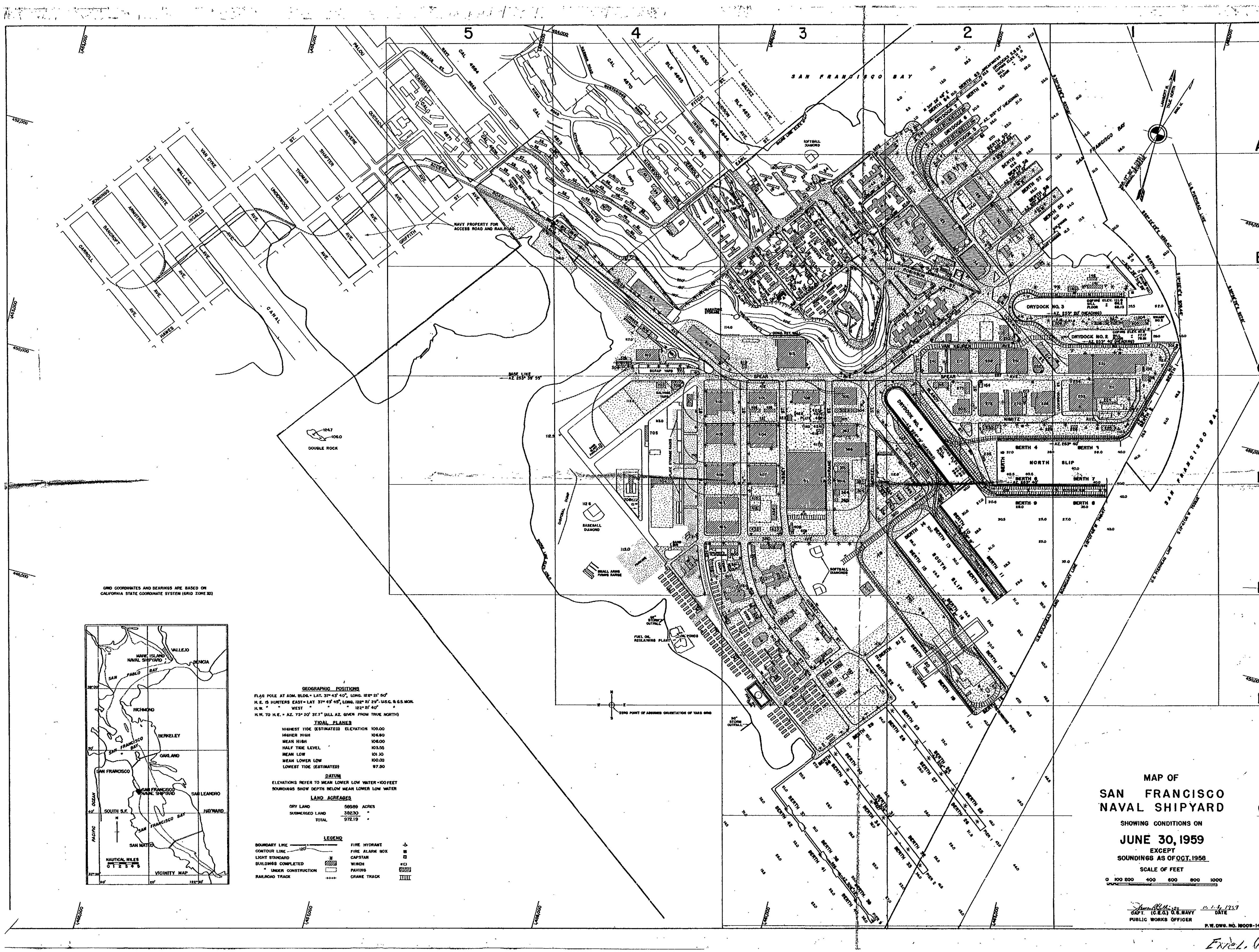
Figure C6
Site Map - Circa 1951



Not to Scale

Notes:

Image shown per Map ID 317.

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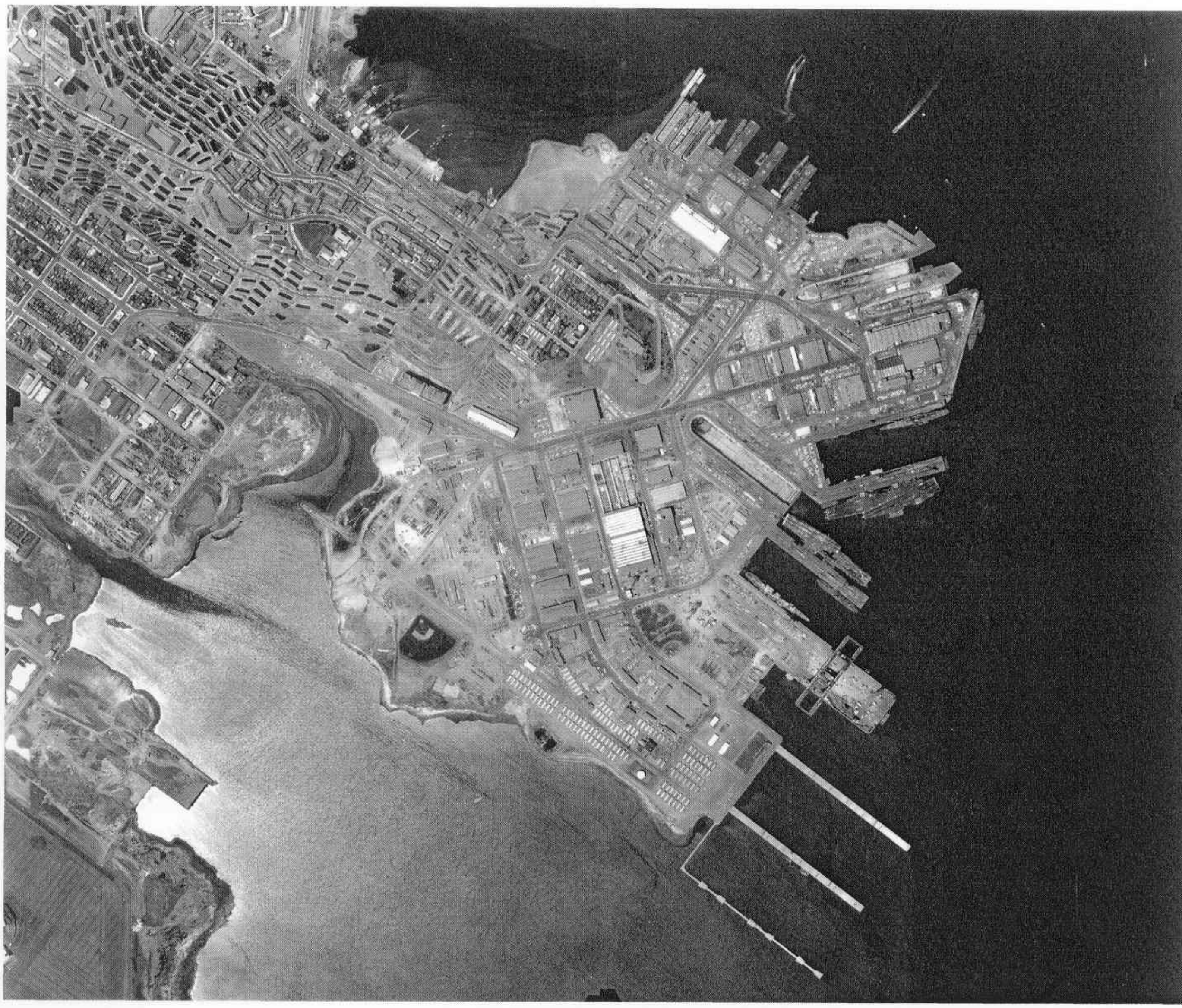
Figure C7
Site Map - Circa 1959



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Hunters Point Naval Shipyard
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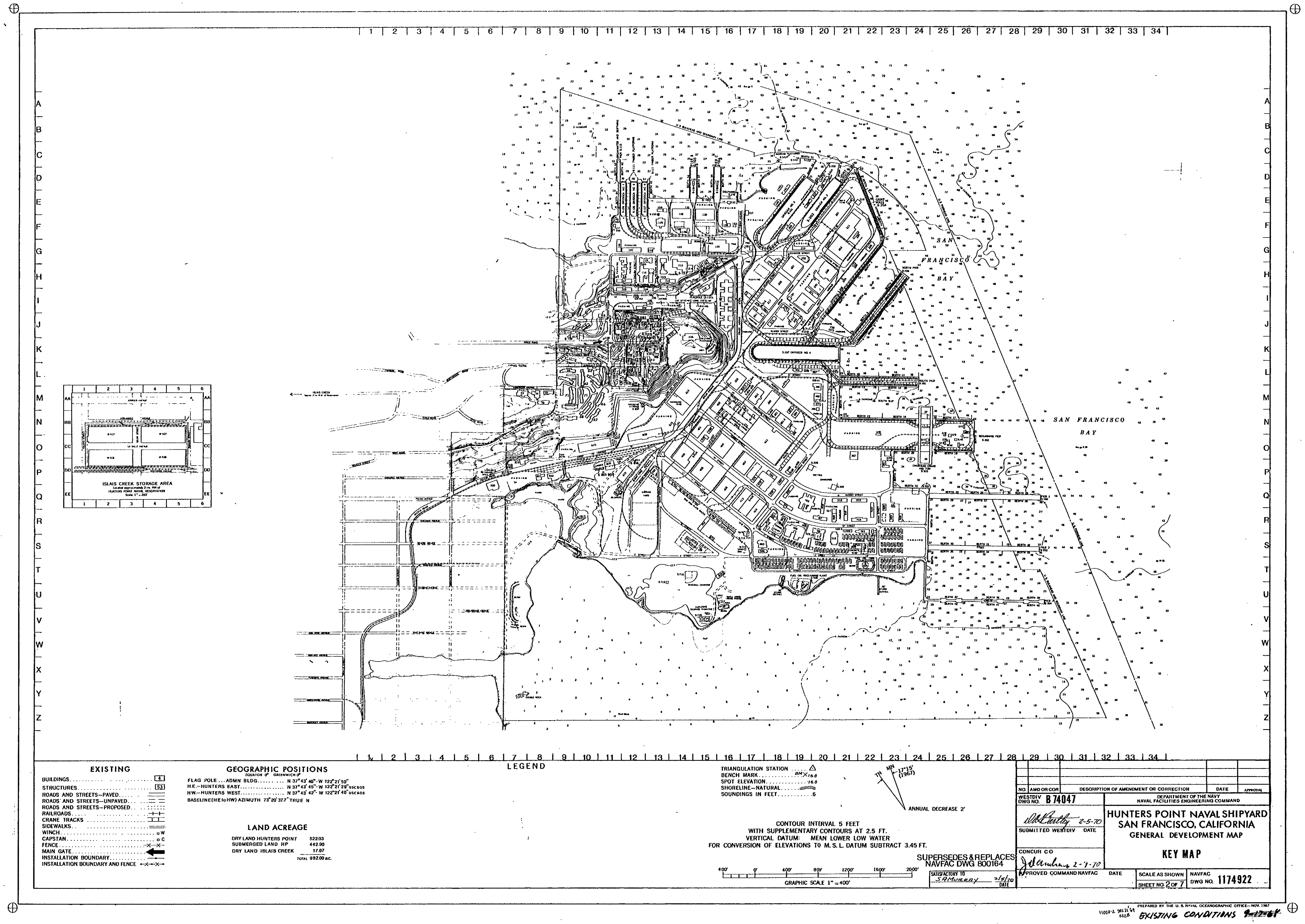
January, 2004

Historical Radiological Assessment

1961 Aerial Photo

Figure C8



Not to Scale

Notes:

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January, 2004

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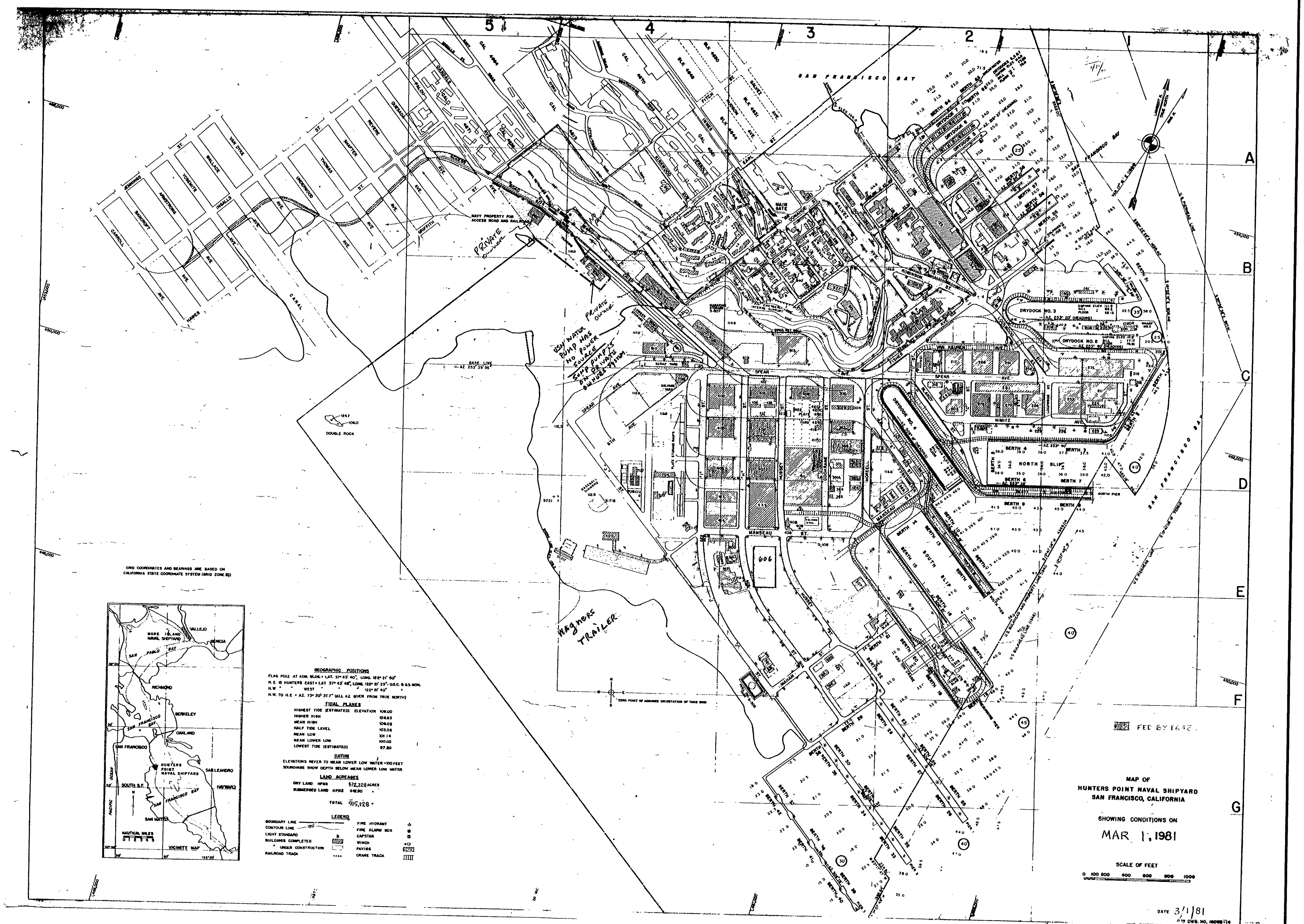
Figure C9

Site Map - Circa 1970



Not to Scale

Notes:

Image shown per Map ID 318.

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Assessment

January, 2004

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Figure C10
Site Map - Circa 1981

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January, 2004

Historical Radiological Assessment

1986 Aerial Photo

Figure C11

APPENDIX D
ELECTRONIC COPIES OF REFERENCE DOCUMENTS